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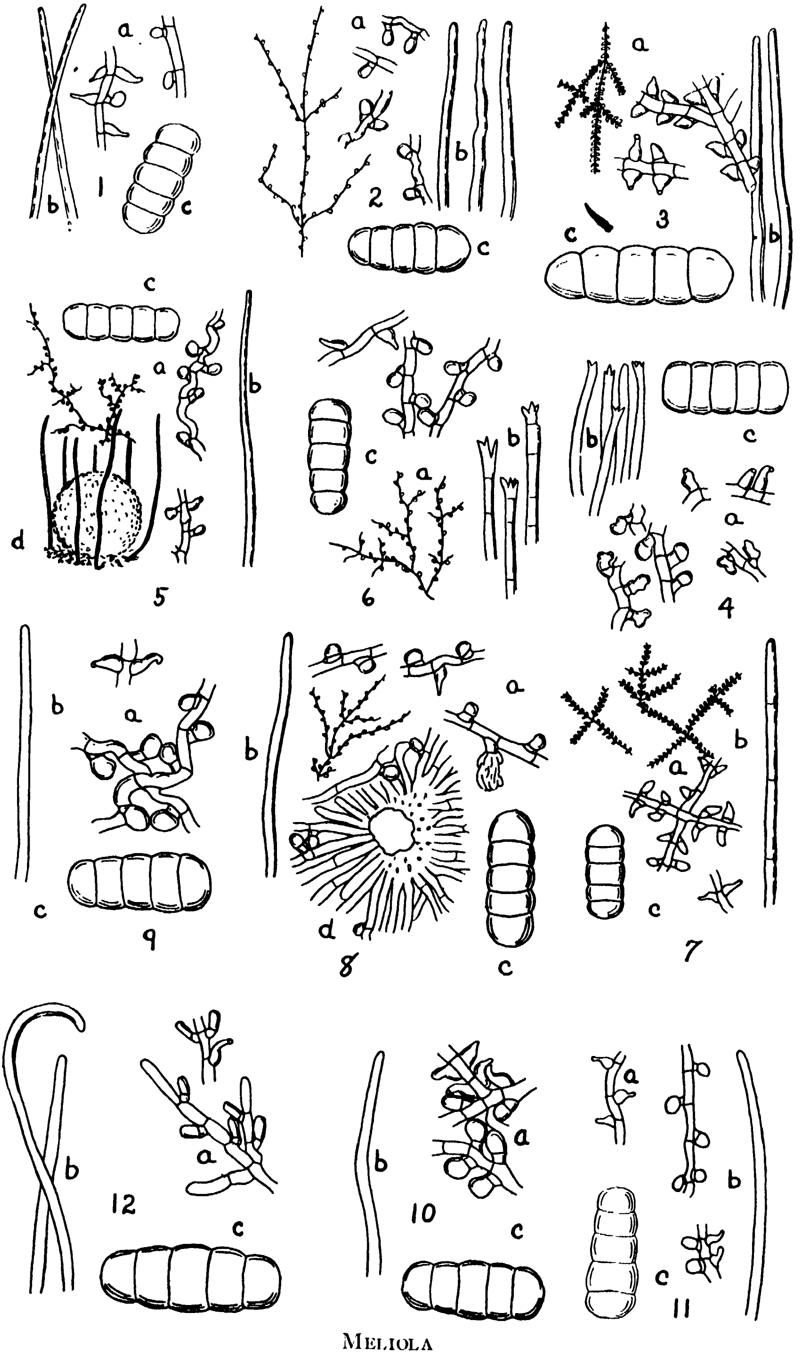
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MELIOLA

MYCOLOGIA

VOL. XVIII JAN.-FEB., 1926 NO. 1

SPECIES OF MELIOLA AND IRENE FROM BRITISH GUIANA AND TRINIDAD

F. L. STEVENS AND L. R. TEHON

(WITH PLATES 1 AND 2)

Some of the species of *Meliola* and *Irene* collected by the senior author in British Guiana and Trinidad during the summer of 1922 are described in this paper. The route of travel, and the points where collections were made, have been recounted in a previous article [1] which also gives in some detail the floral and topographic features encountered.

Although only a portion of the specimens obtained are being reported they may be considered in some degree representative of the Island of Trinidad, and of the tropical part of South America visited, inland to a depth of about 150 miles. The remainder of the specimens will form the subject of a future paper.

We are using the distinction between the genera *Meliola* and *Irene*, as set forth by Theissen and Sydow,[2] as a convenient though admittedly artificial grouping of the species. A more natural grouping might be attained by using, as did Theissen [3] in establishing the genus *Amazonia*, the characters of the mature

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[1] STEVENS, F. L. Parasitic fungi from British Guiana and Trinidad. Illinois Biological Monographs **8**: No. 3. 1923.

[2] SYDOW, H. & P. Beitrag zur Kenntnis der Pilzflora der Philippinen-Inseln. Ann. Myc. **15**: 165-(194)-268. 1917.

[3] THEISSEN, F. Ueber einige Mikrothyriaceen. Ann. Myc. **11**: 493-(499)-511. 1913.

[MYCOLOGIA for November-December (**17**: 225-276) was issued November 1, 1925]

perithecium. The true nature of a perithecium is not, however, always apparent at maturity and the process of development would have to be considered in detail. Throughout the Meliolineae perithecia characteristically arise from capitate hyphopodia through a pseudoradiate proliferation of cells. This proliferation is confined, in the typical species, to the formation of spherical perithecia; but in atypical ones it is carried further in one or the other of two directions: First it may produce a dimidiate perithecium, almost truly radiate, with very evident similarity to true Microthyriaceae. Second, it may produce a spherical perithecium and a more or less compact, pseudoradiate hyphal subiculum. In the first case species of *Amazonia* result, while in the second case the species are similar to those noted especially by Spegazzini[4] in his recent monograph of Argentine Meliolas. Treatment of the genus on this basis would require, however, a detailed study of all its species—a task much beyond the scope of our paper. Several of the species which we are now reporting show marked intergradations between typical species of *Meliola* and the two atypical extremes.

The characters exhibited by the species we are reporting are such as to lead us to suggest that, contrary to the usual belief, spherical rather than dimidiate perithecia represent the pinnacle of development. It is conceivable that the impulse toward cell proliferation by such fixed structures as capitate hyphopodia would at first be diffused, resulting in the production of an abundance of mycelial strands of a purely vegetative nature and an indistinctive, flattened perithecium such as is found in *Amazonia*. The gradual definition of the proliferation impulse would result first in a submergence of the hyphal tendency and an accentuation of the perithecial tendency with spherical perithecia and loose pseudoradiate subicles as the result; but finally in a complete elimination of hyphal formation and an ultimate perithecium spherical in shape and lacking in any except the most meagre of hyphal connections.

In the following pages we have arranged species according to their hosts, in the host sequence of the "Genera Siphonogamarum" of Dalla Torre and Harms. But in the key, which precedes the descriptive text, we have endeavored to bring similar species close together without reference to their host relations, and to point out the most tangible of separating characters, although of course these will not be wholly representative of their differences. To the description of each new species there is appended a "group number" which summarizes its salient morphological characters in the manner proposed by Beeli;[5] for old species this number, readily available in Beeli's article, has been omitted. The Beeli key, of which we speak frequently, is found in the citation just mentioned. Host determinations were made by N. L. Britton, of the New York Botanical Garden.

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[4] SPEGAZZINI, C. Revisión de las Meliolas Argentinas. An. Museo Nac. Hist. Nat. Buenos Aires **32**: 339–393. 1924.

MELIOLA

(Mycelial setae present)

- Perithecial and mycelial setae present . . . . 10. *M. byrsonimina*
- Perithecial setae lacking.
  - Mycelial setae simple.
    - Capitate hyphopodia definitely opposite, conical.
      - Basal cells very short, 1.5–2 μ . . . . 7. *M. conigera*
      - Basal cells longer, 3.5–4 μ . . . . 3. *M. angusta*
    - Capitate hyphopodia alternate or less definitely arranged.
      - End cells of the ascospores acute . . . . 18. *M. olecranonis*
      - End cells obtuse.
        - Branching definitely opposite, though variable.
          - Maculicole . . . . 20. *M. gnathonella*
          - Not maculicole.
            - Setal tips often falciform . . . . 12. *M. Euphorbiae*
            - Setal tips straight.
              - Setae short—up to 300 μ.
                - Perithecia small, 90 μ or less. 11. *M. Manihot*
                - Perithecia larger, over 100 μ.
                  - Spores small, 22 μ long . . 19. *M. Lisianthi*
                  - Spores longer, 30–40 μ.
                    - Colonies extensive . . . 2. *M. Coccolobis*
                    - Colonies small, 3 mm. in diam . . . . 8. *M. Pithecolobii*
              - Setae longer—400–1000 μ.
                - Internodes 30–40 μ long . . . . 22. *M. Malaneae*
                - Internodes much shorter . . . 9. *M. byrsonimicola*
        - Branching alternate, or indefinite.

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[5] BEELI, M. Note sur le genre Meliola Fr. Bul. du Jard. Bot. de l'etat Bruxelles 7: 89–160. 1920.

Ascospores clavate.................. 21. *M. amphigena*
Ascospores not clavate.
Mucronate hyphopodia long, 17–22 μ.......................... 1. *M. Aristolochiae*
Mucronate hyphopodia shorter, 14–16 μ.......................... 5. *M. Meibomiae*
Mycelial setae crenulate, dentate, or definitely branched.
Capitate hyphopodia opposite................ 16. *M. serjaniicola*
Capitate hyphopodia alternate.
Setae definitely and dichotomously branched. 14. *M. Tapirirae*
Setae merely dentate or crenulate.
Mycelial branching opposite............ 4. *M. varicuspis*
Mycelial branching alternate or indefinite.
Internodes long, 20–60 μ............ 13. *M. Alchorneae*
Internodes much shorter.
Setal tips dentate............... 6. *M. trinidadensis*
Setal tips crenulate.
Hyphopodial head cells 14–15 μ in diam.................. 15. *M. tapiriricola*
Hyphopodial head cells 7–10 μ in diam.................. 17. *M. rhamnicola*

IRENE

(Mycelial setae absent)

Perithecia setose.
Setae straight.
Mycelial branching opposite .... 27. *I. Ingae*
Mycelial branching alternate .... 30. *I. sidicola*
Setae spiraled................................ 24. *I. toruloidea*
Setae uncinate.............................. 28. *I. Crotonis*
Perithecia glabrous.
Hyphae forming marked angles.
Spores large, 44–54 × 12–17 μ................ 26. *I. cubitorum*
Spores smaller, 28–37 × 14 μ................ 25. *I. cubitella*
Hyphae straight or undulate, not angling.
Spores large, up to 50 μ long................ 23. *I. glabroides*
Spores shorter, up to 40 μ long.
Host a Euphorbiacea.................. 29. *I. Alchorneae*
Host a Marcgraviacea.................. 31. *I. Marcgraviae*

1. **Meliola Aristolochiae** Stevens & Tehon, n. sp.

Colonies small, amphigenous but more often epiphyllous, diffuse, 1–5 mm. in diameter. Mycelium somewhat undulate, 6.5–7 μ in diameter, cells about 32–35 μ long; branching opposite or alternate. Capitate hyphopodia alternate; head cells globose or recurved, 10–12 × 8–12 μ, rarely ovate; basal cells short, 3–3.5 μ long. Mucronate hyphopodia not abundant, bottle-shaped, alternate or opposite, 17–22 μ long. Mycelial setae straight, black, extremely variable in length, 365–661 μ long, about 8–8.5 μ in diameter; tips obtuse or rarely acute. Perithecial setae none. Perithecia scattered, rough, spherical, 62–132 μ in diameter. Asci 2-spored, soon evanescent. Ascospores brown, obtuse, 4-septate, constricted at the septa, 36–42 × 14–15 μ. (Pl. 1, Fig. 1.)

Group No. 3111–322⅔.

On *Aristolochia* sp.

British Guiana: Rockstone, July 17, 1922, No. *459* (type); Kartabo, July 22, No. *453*; July 24, No. *673*; Tumatumari, July 10, Nos. *107*, *108*; July 11, No. *165*.

In Beeli's key this species falls next to *M. panicicola* Syd., from which it is, however, readily distinguished by the character of its capitate hyphopodia and its generally smaller perithecia.

2. **Meliola Coccolobis** Stevens & Tehon, n. sp.

Colonies hypophyllous or rarely epiphyllous, large, irregular, and diffuse. Mycelium crooked, 5–7.5 μ in diameter; branching mostly opposite. Capitate hyphopodia alternate, though rarely opposite; head cells round to ovoid, 7.5 × 7.5–10 μ; basal cells short, 3.5–4 μ long. Mucronate hyphopodia not abundant, alternate or opposite, bottle-shaped, 17 μ long. Mycelial setae straight or curved, black, opaque, 170–300 μ long; tips obtuse and oftentimes irregularly wavy. Perithecial setae none. Perithecia spherical, rough, 140–175 μ in diameter, arising from a pseudoradiate subiculum. Asci evanescent. Ascospores 4-septate, brown, obtuse, constricted at the septa, 33–38 × 10–14.5 μ. (Pl. 1, Fig. 2.)

Group No. 3111–3221.

On *Coccolobis* sp.

British Guiana: Kartabo, July 24, 1922, No. *655* (type).

Trinidad: Cumuto, August 16, No. *903*.

This species is similar to *M. rectangularis* Stev. in having a crooked mycelium; but differs in having mycelial setae and in the mode of branching which is not typically at right angles. In the Beeli key it would fall next to *M. Makilingiana* Syd., with which it could not, however, be confused.

A *Meliola* which appears identical with the above occurs on a species of *Coccolobis* collected at Cumuto, Trinidad, August 16 (No. *903*). It bears no perithecia or spores; the mycelium is slightly coarser; and the mycelial setae are noticeably crooked.

3. **Meliola angusta** Stevens & Tehon, n. sp.

Colonies amphigenous, small or large, not definitely limited, and often diffused. Mycelium straight, 7–7.5 μ in diameter; branching opposite and typically at about a 45° angle. Capitate hyphopodia abundant, opposite, two to every cell; head cells ovoid to conic, 10.5 × 14 μ; basal cells short, 3.5–4 μ long. Mucronate hyphopodia common, opposite or opposite a capitate hyphopodium, ampuliform. Mycelial setae straight, black, 435–850 × 10 μ; tips obtuse. Perithecial setae none. Perithecia scattered, mostly toward the periphery of the colony, rough, 65–185 μ in diameter, seated upon a loose pseudoradiate subiculum. Asci evanescent. Ascospores 4-septate, brown, ends obtuse, constricted at the septa, 14–18 × 37–39 μ. (PL. 1, FIG. 3.)

Group No. 3112–3213.

On *Coccolobis* sp.

BRITISH GUIANA: Kartabo, July 22, 1922, Nos. *558* (type), *514*, *539*; July 23, No. *576*; Rockstone, July 17, Nos. *478*, *487*.

This *Meliola* appears in all its forms only on the type specimen. The several fragments must, however, because of their evident similarity, be considered as belonging to a single species.

The species appears to be one not previously described. In its general aspect it is suggestive of *M. praetervisa* Gail., but differs in its remarkably straight mycelium, the constant angle of its branching, the shape of the capitate hyphopodia, and especially in its spores, which are hardly more than half the size ascribed to Gaillard's species. In the Beeli key it would be placed just before *M. Merremiae* Rehm., from which it is, however, quite distinct.

This and the preceding *Meliola*, so different from each other and from species previously known on their host plant, furnish another opportunity for speculation as to the derivation and relationship of species. *M. Coccolobis* is similar in a general way to *M. rectangularis* which occurs on *Coccolobis* in Porto Rico. The second species is similar to *M. praetervisa*, which also occurs on *Coccolobis* in Porto Rico. The first two have in common crooked mycelium and alternate capitate hyphopodia, the second two straight mycelium and opposite hyphopodia. This arrangement suggests two possibilities: That one of each pair may have been derived from the other; or, that the two pairs represent possible divergent lines of derivation from a common ancestor. The second possibility seems to be the more plausible, since certain characters, such as the presence of setae and definitely-angled branching, which may be supposed to have been characteristic of the ancestral *Meliola*, have not been definitely segregated among the younger species. Thus setae are present on both South American species but occur only on *M. praetervisa* in Porto Rico, while a definite angle of branching is associated with mycelium and opposite hyphopodia in South America but with a crooked mycelium and alternate hyphopodia in Porto Rico.

4. **Meliola varicuspis** Stevens & Tehon, n. sp.

Colonies amphigenous, large, and diffuse. Mycelium crooked, rather densely netted, 7–7.5 μ in diameter; branching chiefly opposite. Capitate hyphopodia abundant, alternate; head cells variable in shape from cylindrical to lobed, the lobed ones predominating, 14 × 8.5 μ; basal cells usually short, 2.5–3.5 μ long. Mucronate hyphopodia few, often on special branches, irregularly arranged, flask-shaped, 18–21 μ long. Mycelial setae abundant toward the center of the colony, straight, black, opaque, 275–460 μ long; tips frequently entire and obtuse, but more often denticulate with 2 to 4 small, obtuse, divergent teeth rarely more than 3 μ long. Perithecial setae none. Perithecia common, slightly gregarious in the center of the colony, spherical, rough, 125–210 μ in diameter, seated on a pseudoradiate subiculum. Asci evanescent. Ascospores brown, 4-septate, tips obtuse, distinctly constricted at the septa, 41 × 14.5 μ. (PL. 1, FIG. 4.)

Group No. 31 ⅓ 1–3222.

On an undetermined Annonacea.

COSTA RICA: Aserri, June 26, 1923, No. *132* (type).

As the group number indicates, this species, because of its dentate setae, is readily distinguished from the two species, *M. longipoda* Gail. and *M. Popowiae* Doidge, hitherto described on members of this host family. In the Beeli key it falls next to *M. Imperatae* Syd., with which it has many gross characters in common, but from which it is separated by differences in spore size, setal characters, and mycelial branching.

5. **Meliola Meibomiae** Stevens & Tehon, n. sp.

Colonies amphigenous but more commonly epiphyllous, small, indeterminate, diffuse, and often confluent. Mycelium flexuous to crooked, 7 μ wide; branching both alternate and opposite. Capitate hyphopodia mostly alternate; the head cells globose, 10 μ in diameter; the basal cells short, 1.5–2 μ long. Mucronate hyphopodia few, bottle-shaped, alternate or opposite the capitate, 14–16 μ long. Mycelial setae common, straight or somewhat flexed, dark but not opaque, multicellular, 196–390 μ long; tips obtuse. Perithecial setae none. Perithecia usually numerous, globose, rough, scattered, 90–135 μ in diameter. Asci evanescent. Ascospores 4-septate, brown, obtuse, 32–37 × 10–14 μ. (PL. 1, FIG. 5.)

Group No. 3111–3222.

On *Meibomia* sp.

BRITISH GUIANA: Rockstone, July 16, 1922, No. *434* (type), July 13, No. *257*; Kartabo, July 24, No. *650*.

This species would fall next to *M. gymnanthicola* Stev. in the Beeli key. It is the first to be described on its host from the Americas, and it is remarkable that while there are already six species and an additional variety known on *Meibomia*, none of them is capable of being confused with our species.

6. **Meliola trinidadensis** Stevens & Tehon, n. sp.

Colonies epiphyllous, small, dense, circular, limited, 0.5–1 mm. in diameter. Mycelium coarse, flexuous, closely interwoven, 8–10 μ wide; branching alternate or opposite. Capitate hyphopodia alternate, often divergent; head cells globose, 10 μ in diameter; basal cells short, 2–2.5 μ long. Mucronate hyphopodia few, ampuliform, 15 μ long. Mycelial setae numerous, long, brown, translucent, multiseptate, not tapering markedly, 300–525 μ long, tips blunt and finely dentate. Perithecial setae absent. Perithecia black, globose, rough, 100–155 μ in diameter. Asci evanescent. Ascospores usually dark brown, 4-septate, clavate, constricted, obtuse, 10 11 × 35–36 μ. (PL. 1, FIG. 6.)

Group No. 3131–3123.

On *Meibomia* sp.

TRINIDAD: St. Augustine, August 13, 1922, No. *825* (type).

In the Beeli key this species falls just before *M. fuscidula* Gail., from which it is entirely distinct. The number of species of *Meliola* reported on members of the genus *Meibomia* is already large—including at least seven forms. Most of these, however, appear reasonably distinct, and our species can not readily be confused with any of them.

7. **Meliola conigera** Stevens & Tehon, n. sp.

Colonies amphigenous, covering about half the surface of the pinnule. Mycelium nearly straight, 7–7.5 μ wide; branching opposite. Capitate hyphopodia abundant, opposite, 2 to each cell, simulating mucronate hyphopodia; head cells conic or flexed-conic, 9–11 μ long; basal cells short, 1.5–2 μ long. Mucronate hyphopodia ampuliform, opposite, 17 μ long. Mycelial setae few, straight, 100–125 μ long. Perithecial setae absent. Perithecia flat and radiate when young, globular and apparently parenchymatous when mature, about 225 μ in diameter, seated upon a heavy pseudoradiate subicle. Asci evanescent. Ascospores 4-septate, brown, constricted at the septa, 28–35 × 9–10 μ. (PL. 1, FIG. 7.)

Group No. 3112–3131.

On *Pentaclethra* sp.

BRITISH GUIANA: Demerara-Essequibo Railroad, July 15, 1922, No. *387a* (type); Wismar, July 14, No. *290*.

On *Pentaclethra macroloba*.

BRITISH GUIANA: Kartabo, July 22, No. *529*.

This species is remarkable in the character of its capitate hyphopodia, which, under the low power of the microscope, appear to simulate mucronate hyphopodia. In this respect it resembles *M. ampulifera* Winter, but is not to be confused with Winter's species, since its hyphopodia have both basal and head cells.

In the Beeli key it falls just before *M. Acalyphae* Rehm., from which it is readily distinguished by perithecial and spore characters.

8. **Meliola Pithecolobii** Stevens & Tehon, n. sp.

Colonies epiphyllous, small, round, dense, 0.5–3 mm. in diameter. Mycelium straight, radially disposed, densely interwoven, rather coarse, 8–8.5 μ in diameter; branching opposite. Capitate hyphopodia alternate, numerous; head cells globose to ovate, 10–12 μ in diameter; basal cells short, not equilateral, 3.5 μ long. Mucronate hyphopodia rare, alternate, ampuliform, 15–17 μ long. Mycelial setae few, much scattered, straight, not translucent, obtuse, 200–250 μ long. Perithecia glabrous, spherical, black, rough, 105–120 μ in diameter, arising from and seated upon a definite pseudoradiate subiculum, apparently ostiolate. Asci evanescent. Ascospores brown, 4-septate, constricted, obtuse, 37–39 × 15 μ. (PL. 1, FIG. 8.)

Group No. 3111–3221.

On *Pithecolobium Jupunba.*

TRINIDAD: Cumuto, August 16, 1922, No. *966* (type).

This species and *M. rizalensis* Syd., near which it falls in the Beeli key, have in common the characteristic of rare setae, but are otherwise distinct.

9. **Meliola byrsonimicola** Stevens & Tehon, n. sp.

Colonies amphigenous but more often hypophyllous, small and round, often confluent and then extensive. Mycelium closely netted, crooked, and often angular, rather coarse, 7–8 μ wide; branching mostly opposite. Capitate hypopodia alternate; head cells variable, globose to ovoid, 14–21 x 12 μ; basal cells 6–7 μ long. Mucronate hyphopodia ampuliform, opposite, 25 μ long. Mycelial setae rare over most of the colony but abundant near the perithecia, large, multi-septate, translucent, 10–12 μ wide and 400–700 μ long; tips obtuse. Perithecial setae none. Perithecia globose, black, rough, 105–180 μ in diameter. Asci 2-spored, evanescent. Ascospores brown, 4-septate, constricted, obtuse, 42–46 × 17 μ. (PL. 1, FIG. 9.)

Group No. 3111–4233.

On *Byrsonima* sp.

BRITISH GUIANA: Demerara-Essequibo Railroad, July 15, 1922, No. *333* (type), and No. *363.*

This species is, in many respects, similar to *M. Byrsonimae* Stev., but it is distinguishable especially because of its crooked, closely-netted mycelium. The setae appear generally shorter, and are constantly obtusely pointed, and the spores are not so long. In the Beeli key our species falls next to *M. Lucumae* Stev., from which it is however wholly distinct.

This *Meliola* occurs on a different species of the same host genus, with the collection number *1015*, for which no place or date of collection is recorded.

10. **Meliola byrsonimina** Stevens & Tehon, n. sp.

Colonies amphigenous, minute, compact, round. Mycelium straight, dark, much branched, rather coarse, 10 μ in diameter; branching opposite. Capitate hyphopodia abundant, mostly opposite; head cells globose, 14–17 μ in diameter; basal cells variable, usually 5–7 μ long. Mycelial setae few, straight, tapering, 300–350 μ long; tips obtuse. Perithecial setae several, arising from the base of the perithecium, straight, tapering, black, not translucent, 200–350 μ long; tips obtuse. Perithecia black, spherical, rough, 150–175 μ in diameter. Asci 2-spored, evanescent. Ascospores 4-septate, brown, markedly constricted at the septa, ends obtuse, 35–46 × 14–17 μ. (PL. 1, FIG. 10.)

Group No. 3412–3232.

On *Byrsonima* sp.

BRITISH GUIANA: Tumatumari, July 10, 1922, No. *106* (type).

This species is entirely distinct in all its characters from the species of *Meliola* already described on its host. It is remarkable because of the density of the hyphopodia, both mucronate and capitate, on the short, straight branches of the mycelium. In the Beeli key it falls next to *M. macrochaeta* Syd. from which it is readily distinguished by its entire, bluntly tipped setae.

11. **Meliola Manihot** Stevens & Tehon, n. sp.

Colonies epiphyllous, minute, round, diffuse. Mycelium straight or slightly flexuous, loosely interwoven, 6–7 μ wide; branching opposite. Capitate hyphopodia mostly alternate, rarely opposite; head cells globose, 7–9 μ in diameter; basal cells short, 2.5–3 μ long. Mucronate hyphopodia frequent, alternate or opposite, or opposite the capitate, ampuliform, 10 12 μ long. Mycelial setae few, well distributed, black, obtuse, 200–250 μ long. Perithecial setae absent. Perithecia black, spherical, rough, 70–90 μ in diameter, usually seated on a close subiculum of light-brown, pseudoradiating, indeterminate hyphae. Asci 2-spored, evanescent. Ascospores light brown, 4-septate, clavate, not greatly constricted, 30–31 × 14 μ. (PL. 1, FIG. 11.)

Group No. 3111–2211.

On *Manihot palmata.*

BRITISH GUIANA: Tumatumari, July 12, 1922, No. *217* (type).

This species, a very unusual one, falls, in the Beeli key, next to *M. microspora* Pat. & Gail. It is not to be confused with either of the two species hitherto recorded on *Manihot.* The perithecial subiculum and the clavate spores are among its most distinguishing characters.

12. **Meliola Euphorbiae** Stevens & Tehon, n. sp.

Colonies small, round, hypophyllous, heavy, 2–5 mm. in diameter. Mycelium closely interwoven, straight or flexuous, 6.5–7.5 μ in diameter; branching opposite. Capitate hyphopodia alternate generally though often opposite, numerous; head cells cylindrical, 14–15 μ long; basal cells 2.5–3 μ long. Mucronate hyphopodia rare, alternate, bottle-shaped, 8–12 μ long. Mycelial setae abundant, black, not translucent, straight or falciform, 320–380 μ long; tips obtuse. Perithecial setae absent. Perithecia black, spherical, rough, 60–75 μ in diameter. Asci evanescent. Ascospores brown, 4-septate, constricted at the septa, end cells obtuse, 43 × 17 μ. (PL. 2, FIG. 12.)

Group No. 3111–4212.

On an undetermined Euphorbiacea.

BRITISH GUIANA: Kartabo, July 24, 1922, No. *663* (type).

In the Beeli key this species falls next to *M. micromera* Syd., but is nearer *M. Canarii* Syd. morphologically.

13. **Meliola Alchorneae** Stevens & Tehon, n. sp.

Colonies hypophyllous, round, thin and diffused, small or large. Mycelium loosely interwoven, flexuose, rather fine, 5–6.5 μ wide, cells 45–50 μ long; branching alternate and opposite. Capitate hyphopodia alternate; head cells globose, small, 10 μ in diameter; basal cells 7–10 μ long. Mycelial setae numerous, straight or flexuous, black, not translucent, 340–470 μ long; tips mostly obtuse though often slightly crenulate or very rarely denticulate. Perithecial setae absent. Perithecia spherical, black, rough, 175–180 μ in diameter, seated upon a loose, pseudoradiate subiculum which disappears with age. Asci 2-spored, evanescent. Ascospores brown, 4-septate, constricted at the septa, ends obtuse, 35 × 10 μ. (PL. 2, FIG. 13.)

Group No. 3111–3122.

On *Alchornea* sp.

BRITISH GUIANA: Tumatumari, July 11, 1922, No. *198* (type).

Distinct from any thus far described on Euphorbiaceous hosts, this species, with its graceful, fine mycelium and knob-like capitate hyphopodia, is both striking and unusual. The variation exhibited by the tips of the setae, the majority being straight and blunt but a minority with irregularities ranging from slight crenulations to definite denticulations, furnishes an illustration of the unreliability of certain structures for diagnostic purposes within one species, though the same structures within another species may furnish the most reliable of diagnostic features.

14. ***Meliola Tapirirae*** *Stevens & Tehon, n. sp.*

Colonies epiphyllous, thin and diffuse when small, dense and matted when old, glabrous at the periphery, and often densely setose in the center. Mycelium straight or flexuous, rather coarse, 7.5–8.5 μ wide; branching opposite. Capitate hyphopodia alternate; head cells ovoid to oblong, 10–14.5 μ long; basal cells short, 3.5 μ long. Mucronate hyphopodia narrowly ampuliform, alternate, 18 μ long. Mycelial setae usually abundant and often matted in the center of the colony, black, opaque, and dichotomously branched, 200–280 μ long; branches often 30–40 μ long with dichotomously denticulate apices. Perithecial setae absent. Perithecia black, spherical, rough, 115–190 μ in diameter, seated upon a loose pseudoradiate subiculum. Asci evanescent. Ascospores brown, 4-septate, slightly constricted, obtuse, 35–38 × 17–20 μ. (PL. 2, FIG. 14.)

Group No. 3141–3221.

On *Tapirira* sp.

No species of *Meliola* having much-branched setae has yet been reported on any member of the Anacardiaceae. The present species is the first of its kind to be noted on host-members of this family, and is also the first *Meliola* to be recorded on *Tapirira*. In the Beeli key it falls next to *M. Merrillii* Syd.

15. **Meliola tapiriricola** Stevens & Tehon, n. sp.

Colonies epiphyllous, small, round, thin, limited, 2–5 mm. in diameter. Mycelium flexuous, irregular, closely interwoven, 6–7 μ wide; branching alternate. Capitate hyphopodia alternate, numerous; head cells globose, 14–15 μ in diameter; basal cells variable, not often equilateral, 1.5–5 μ long. Mucronate hyphopodia rare, conical to flask-shaped, 15–17 μ long. Mycelial setae numerous, well distributed, rather coarse, semi-translucent, not tapered apically, terminally crenulate for a distance of 30 μ or more, 170–200 μ long. Perithecial setae lacking. Perithecia globose, rough, 142–150 μ in diameter. Asci evanescent. Ascospores brown, 4-septate, obtuse, constricted, 32–35 × 10–12 μ. (PL. 2, FIG. 15.)

Group No. 3131–3221.

On *Tapirira guianensis.*

BRITISH GUIANA: Wismar, July 14, 1922, No. *283* (type).

This species, whose outstanding characteristic is the crenulate setal tips, falls next to *M. crenatissima* Syd. in the Beeli key. It is very similar in many respects to Sydow's species, but its crenu-

lations when compared with those figured by Sydow are much more marked and really deserve the superlative in description.

16. **Meliola serjaniicola** Stevens & Tehon, n. sp.

Colonies hypophyllous, small, round, diffuse, 0.5–3 mm. in diameter. Mycelium densely interwoven, straight, radially arranged, coarse, 10 μ in diameter; branching opposite. Capitate hyphopodia opposite, two to every cell; head cells globose, 14 μ in diameter; basal cells short and nearly equilateral, 1.5–2 μ long. Mucronate hyphopodia very rare, bottle-shaped, 20–22 μ long. Mycelial setae abundant, coarse, black, not tapering, apically divided into two to many teeth, 230 μ or more long. Perithecial setae absent. Perithecia spherical, black, rough, 140–150 μ in diameter. Asci evanescent. Ascospores brown, 4-septate, constricted, the middle cell of greater diameter than the others, ends obtuse, 37–40 × 17–18 μ. (PL. 2, FIG. 16.)

Group No. 3132–3222.

On *Serjania paucidentata.*

BRITISH GUIANA: Coverden, August 8, 1922, No. *798* (type).

This species, which falls next to *M. fuscidula* Gail. in the Beeli key, can not readily be confused with any of the species hitherto recorded on Sapindaceous hosts.

17. **Meliola rhamnicola** Stevens & Tehon, n. sp.

Colonies hypophyllous, thin, diffuse, and not limited, 1.5 cm. or more in diameter. Mycelium small and delicate, wavy, and closely interwoven, 4.5–6 μ wide; branching opposite. Capitate hyphopodia alternate, often arranged along one side of the hypha for some distance, extending outward at a wide angle; head cells globose, 7–10 μ in diameter; basal cells short but distinct and nearly equilateral, 3.5–4.5 μ long. Mucronate hyphopodia not abundant, alternate, bottle-shaped, 12 μ long. Mycelial setae straight or flexuous, black, not translucent, tips obtuse or variously formed from crenulate to dentate, 325–375 μ long. Perithecial setae none. Perithecia globose, black, rough, 150–175 μ in diameter, seated on a loose, pseudoradiate subiculum. Asci 2-spored, evanescent. Ascospores brown, 4-septate, very slightly constricted, 12–14 × 25–28 μ. (PL. 2, FIG. 17.)

Group No. 31 ⅓ 1–2222.

On *Gouania* sp. (?).

BRITISH GUIANA: Tumatumari, July 11, 1922, No. *203* (type).

This species, the second to be described on a Rhamnacea, falls *after M. anceps Syd., in the Beeli key; but its delicate and graceful hyphae and its strikingly shaped, prominent, and spreading* hyphopodia characterize it definitely as a separate species.

18. **Meliola olecranonis** Stevens & Tehon, n. sp.

Colonies hypophyllous, circular, limited, 5-10 mm. in diameter, dense. Mycelium densely interwoven, extremely crooked, 6–7 μ wide, the hyphal strands often forming elbows. Capitate hyphopodia alternate; head cells obovate to subspherical, 10–12 μ long; basal cells short, 3–4 μ long. Mucronate hyphopodia not seen. Mycelial setae abundant, black, opaque, straight, 320–350 μ long; tips entire and tapering but not acute. Perithecial setae absent. Perithecia spherical, black, rough, 125–140 μ in diameter. Asci 2-spored, evanescent. Ascospores brown, 4-septate, constricted, apical cells both acute, usually one more so than the other, 40 × 11 μ. (PL. 2, FIG. 18.)

Group No. 3111–3222.

On *Guajava* sp.

BRITISH GUIANA: Tumatumari, July 8, 1922, No. *64* (type).

This *Meliola*, which is closely similar in mycelial characters to the species *Irene cubitella* and *I. cubitorum* described later in this paper, is remarkable for the abundance of its gracefully tapered setae and the peculiar and distinctive angulation exhibited at the mycelial nodes. The name of the species has been selected because of the projection frequently found at the angles, which is suggestive of an elbow. In the Beeli key, it falls next to *M. velutina* Wint.

19. **Meliola Lisianthi** Stevens & Tehon, n. sp.

Colonies epiphyllous, dense, round, limited, 1–10 mm. in diameter. Mycelium straight or flexuous, loosely interwoven, 6.5–7.5 μ wide; branching mostly opposite. Capitate hyphopodia numerous, alternate; head cells globose, 7-9 μ in diameter; basal cells short, 1.5–3 μ long, not equilateral. Mucronate hyphopodia not abundant, opposite, ampuliform, 12–15 μ long. Perithecia glabrous, often very rough, spherical, pseudo-ostiolate, 107–115 μ in diameter. Asci 2-spored, evanescent. Ascospores brown, 4-septate, deeply constricted, slightly clavate, obtuse, 8.5 × 22 μ. (PL. 2, FIG. 19.)

Group No. 3111–2121.

On *Lisianthus grandiflorus.*

BRITISH GUIANA: Wismar, July 14, 1922, No. *316* (type).

This appears to be the first *Meliola* recorded on a Gentianacea. In the Beeli key it falls just before *M. paraensis* Henn., and is made unique in its group by the small spores which are both unusually short and unusually narrow.

20. **Meliola gnathonella** Stevens & Tehon, n. sp.

Colonies epiphyllous, minute, rarely more than 0.5 mm. in diameter, associated with a definite diseased spot on the host leaf. Mycelium flexuous, rather crowded, 6.5–7 μ wide; branching opposite. Capitate hyphopodia alternate, 15–17 μ long; head cells globose, 12–15 μ in diameter; basal cells 2–3 μ long. Mucronate hyphopodia bottle-shaped, alternate, 15–18 μ long. Mycelial setae arising near the perithecia, black, straight or flexuous, 200–250 μ long; tips obtuse. Perithecial setae absent. Perithecia globose, gregarious or even crowded in the center of the colony, rough, 130–160 μ in diameter. Asci evanescent. Ascospores 4-septate, brown, constricted at the septa, obtuse, slightly clavate, 33–39 × 14 μ. (PL. 2, FIG. 20.)

Group No. 3111–3221.

On *Jacaranda* sp. (?).

BRITISH GUIANA: Tumatumari, July 12, 1922, No. *231* (type).

The only instance, among the species recorded here, of a *Meliola* causing a definitely diseased spot upon the host leaf occurs in connection with this species.

21. **Meliola amphigena** Stevens & Tehon, n. sp.

Colonies amphigenous, small, thin, diffuse, and irregular, 0.5–3 mm. in diameter. Mycelium very dark, straight or flexuous, 6–6.5 μ wide; branching alternate. Capitate hyphopodia alternate; head cells globose to ovate, 7–8.5 μ in diameter, rather closely appressed to the mycelial strands by the very short basal cells which are not equilateral. Mucronate hyphopodia rarely present. Mycelial setae few, scattered, black, opaque, straight, tapering, 275 μ long; tips obtuse. Perithecial setae lacking. Perithecia abundant, scattered, black, spherical, smooth, arising by pseudoradiate cell proliferation from capitate hyphopodia, 90–110 μ in diameter. Asci 2-spored, evanescent. Ascospores brown, 4-septate, constricted, clavate, 28–29 × 10 μ; end cells obtuse. (PL. 2, FIG. 21.)

Group No. 3111–2111.

On an undetermined Rubiacea.

BRITISH GUIANA: Tumatumari, July 11, 1922, No. *168* (type); Rockstone, July 17, 1922, No. *450*; Demerara-Essequibo Railroad, July 15, 1922, No. *413*.

In the Beeli key this species falls just before *M. microspora* Pat. and Gail., and forms the first species of the group, among the members of which it is unique because of the smallness of its perithecia. It is apparently closely related to *M. Psychotriae* Earle.

22. **Meliola Malaneae** Stevens & Tehon, n. sp.

Colonies hypophyllous, large, loose, thin, diffuse, not limited, irregular in outline. Mycelium loosely interwoven, flexuous, 7–7.5 μ wide; branching opposite. Capitate hyphopodia alternate, separating cells of the mycelium 30–40 μ long; head cells ovoid to oblong, 14–17 × 10 μ; basal cells variable from short to rather long, usually narrower than the mycelium, not equilateral, 4–10 μ long by 4.5–6 μ wide. Mucronate hyphopodia numerous, ampuliform, with unusually long necks, mostly opposite, up to 25 μ long. Mycelial setae few, scattered, black, not translucent, straight, 700–1100 μ long, often grouped near the perithecia; tips obtuse. Perithecial setae absent. Perithecia black, spherical, rough, 115-140 μ in diameter, originating from capitate hyphopodia by pseudoradiate cell proliferation, at maturity seated upon a loose subiculum of radiating, indeterminate, light-colored hyphae which often bear hyphopodia. Asci 2-spored, evanescent. Ascospores brown, 4-septate, rather deeply constricted, terminal cells obtuse, central cells often expanded much beyond the others, 46–53 × 16–17 μ. (PL. 2, FIG. 22.)

Group No. 3111–4223.

On *Malanea* sp.

TRINIDAD: Cumuto, August 16, 1922, No. *911* (type).

On *Malanea macrophylla*.

TRINIDAD: Cumuto, August 16, No. *949*.

On *Psychotria* sp.

TRINIDAD: Cumuto, August 16, No. *944*.

This interesting species, which falls just after *M. Roureae* Syd. in the Beeli key, is distinguished from *M. longipoda* Höhnel, which is recorded on at least one Rubiacea and has the same group number, by the presence of mucronate hyphopodia, the shorter setae, and its smaller perithecia.

The specimen on *Psychotria*, which is evidently of the same species and not sufficiently distinct to be recorded as a variety, has spores which measure 53 × 21–22 μ—a difference which modifies the diagnostic number of the species to read 3111–5323 for the form of *Psychotria.*

23. IRENE GLABROIDES (Stevens) Toro, Mycologia **17**: 142. 1925.

Meliola glabroides Stevens, Ill. Biol. Monog. **2**: 18. 1916.

On members of the Annonaceae, genera and species not determined.

BRITISH GUIANA: Kartabo, July 22, 1922, Nos. *569*, *572*; July 24, No. *669*; Demerara-Essequibo Railroad, July 15, No. *379a*; Rockstone, July 16, No. *421.*

On *Nectandra* sp.

BRITISH GUIANA: Wismar, July 14, Nos. *285*, *311*, *315*, *321.*

On *Simaba* sp.

BRITISH GUIANA: Wismar, July 14, No. *309.*

On *Icica* sp.

TRINIDAD: Cumuto, August 16, No. *936.*

On *Sauvagesia erecta.*

BRITISH GUIANA: Rockstone, July 16, No. *432.*

On *Vismia latifolia.*

BRITISH GUIANA: Wismar, July 14, No. *299.*

24. **Irene toruloidea** (Stevens) Stevens & Tehon, n. comb.

Meliola toruloidea Stevens. Ill. Biol. Monog. **2**: 25. 1916.

On *Cassia* sp.

TRINIDAD: Cumuto, August 16, 1922, No. *937.*

The agreement between this specimen and the type from Porto Rico is remarkable as to the size of the colony, perithecia, mycelium and spores, as well as the characteristic perithecial setae.

25. **Irene cubitella** Stevens & Tehon, n. sp.

Colonies hypophyllous, 1–10 mm. in diameter or more. Mycelium crooked and often angular, 6.5–7 μ wide; branching alternate. Capitate hyphopodia alternate, 14–17 μ long; head cells globose, 14 μ in diameter; basal cells 1–3 μ long. Mucronate hyphopodia alternate or opposite, bottle-shaped, 14–18 μ long. Setae none. Perithecia spherical, rough, 56–82 μ in diameter. Spores 4-septate, brown, obtuse, constricted, 28–37 × 14 μ. (PL. 2, FIG. 23.)

Group No. 3101–3210.

On *Cassia* sp.

BRITISH GUIANA: Tumatumari, July 11, 1922, Nos. *119* (type), *193*.

TRINIDAD: Cumuto, August 16, No. *941*.

This species, which falls next to *M. Sandorici* Rehm. in the Beeli key, is suggestive in its general aspect of *I. cubitorum*, which is also described in this paper as occurring on a leguminous host, but is smaller and not to be confused with it.

26. **Irene cubitorum** Stevens & Tehon, n. sp.

Colonies hypophyllous, usually circular, 0.5 cm. in diameter or more. Mycelium very crooked, making a well-defined angle at each cell juncture, the diameter usually increased at the cell unions, and the wall extended outward to form a pointed projection; hyphae 7–9.5 μ wide; branching both alternate and opposite. Capitate hyphopodia alternate; head cells irregularly angular, about 14 μ long; basal cells variable in length, from 3 to 10 μ or more long. Mucronate hyphopodia alternate, irregular, but mostly bottle-shaped, about 20 μ long. Setae none. Perithecia flat when young, globular when mature, rough, 107–152 μ in diameter. Asci 2-spored, evanescent. Ascospores brown, obtuse, constricted at the septa, 4-septate, 44–54 × 12–17 μ. (PL. 2, FIG. 24.)

Group No. 3101–5220.

On *Dimorphandra latifolia*.

BRITISH GUIANA: Coverden, August 8, 1922, No. *810* (type); Demerara-Essequibo Railroad, July 15, No. *417*.

On *Dimorphandra* sp.

BRITISH GUIANA: Demerara-Essequibo Railroad, July 15, No. *380*.

A startlingly unique appearance is possessed by this species when viewed under the low power of the microscope, for the close intermingling of the hyphae, together with the characteristic angling, reminds one of a wire netting. The species is not similar to any hitherto described on a leguminous host; though it is closely resembled by the smaller, more delicate *Irene cubitella*, described in this paper. In Beeli's key it comes just before *M. calva* Speg., with which, however, it could not possibly be confused.

27. **Irene Ingae** Stevens & Tehon, n. sp.

Colonies hypophyllous, extensive, thin, diffuse. Mycelium delicate, wavy, closely interwoven, 4–4.5 μ wide; branching opposite. Capitate hyphopodia alternate or opposite, or indifferently arranged, widely divergent; head cells globose to ovoid, 10–14 μ in diameter; basal cells 7 μ long. Mucronate hyphopodia alternate, rarely opposite, bottle-shaped, 21 μ long. Mycelial setae lacking. Perithecial setae 3 to 7 in number, attached to the lower half of the perithecium, flexuous but not toruloid, indeterminate though slightly enlarged apically, 100–120 μ long. Perithecia globose, black, rough, 100–115 μ in diameter; hyphae of the perithecial subiculum few, long, divergent and hyphopodiate. Asci 2-spored, evanescent. Ascospores dark brown, 4-septate, slightly constricted, the central cell much larger than the others and spherical, end cells obtuse, 14–16 × 32–39 μ. (PL. 2, FIG. 25.)

Group No. 3401–3220.

On *Inga* sp.

BRITISH GUIANA: Kartabo, July 22, 1922, No. *559* (type).

A first view of the perithecia of this species is suggestive of *M. toruloidea* Stev., which has been reported on a species of the same host genus from Porto Rico. The large size and diffuse nature of the colony, however, is strikingly different, as are also the relatively indifferent arrangement of the capitate hyphopodia and the characters of the perithecial setae. In the Beeli key this species falls next to *M. bayamonensis* Tehon.

28. **Irene Crotonis** Stevens & Tehon, n. sp.

Colonies amphigenous, thin, and minute, discernible upon the leaf only as dark flecks. Mycelium loosely interwoven, slightly flexuous, diverging rather symmetrically, 7–7.5 μ wide; branching opposite. Capitate hyphopodia alternate, abundant; the head cells globose, 10–11 μ in diameter; the basal cells short, not equilateral, 3.5–4 μ long. Mucronate hyphopodia bottle-shaped, opposite or rarely alternate, often segregated on special lateral branches, 14–15 μ long. Mycelial setae none. Perithecial setae subapical, 3 to 5 in number, translucent, apex markedly hooked but not coiled, 90 μ long or less. Perithecia rough, globular, black, 85–100 μ in diameter, seated upon a very loose pseudoradiate subiculum, apparently ostiolate. Asci evanescent. Ascospores brown, oblong, 4-septate, obtuse, 32–35 × 12–14 μ. (PL. 2, FIG. 26.)

Group No. 3301–3210.

On *Croton* sp.

TRINIDAD: St. Augustine, August 13, 1922, No. *837* (type).

In the Beeli key this species falls just before *M. toruloidea* Stev. to which it is very similar though readily distinguishable by its noticeably hooked perithecial setae and very characteristic tendency to segregate the mucronate hyphopodia on lateral hyphal branches.

29. **Irene Alchorneae** Stevens & Tehon, n. sp.

Colonies epiphyllous, small, round, diffuse. Mycelium straight or slightly flexuous, 7 μ wide; branching opposite. Capitate hyphopodia alternate; head cells strikingly globose, rarely ovoid, 17–19 μ in diameter; basal cells short, 1.5–2 μ long. Mucronate hyphopodia rare, opposite, bottle-shaped, 14–17 μ long. Setae none. Perithecia small, globose, nearly smooth, 70 μ in diameter, seated on a loose, pseudoradiate subiculum. Asci evanescent. Ascospores brown, 4-septate, obtuse, 35–40 × 14–17 μ. (PL. 2, FIG. 27.)

Group No. 3101–2210.

On *Alchornea cordata.*

BRITISH GUIANA: Tumatumari, July 12, 1922, No. *245* (type), July 10, No. *153a*.

In the Beeli key this species falls between *M. confragosa* Syd. and *M. usteriana* Rehm. It appears to be quite distinct from any of the species thus far described on members of the Euphorbiaceae.

30. **Irene sidicola** Stevens & Tehon, n. sp.

Colonies hypophyllous, small, round, diffuse, 1–3 mm. in diameter. Mycelium crooked, loosely interwoven, 6–7.5 μ wide; branching alternate. Capitate hyphopodia alternate, irregularly distributed; head cells globose to ovoid and occasionally angled, 7–10 μ in diameter; basal cells variable, 2–7 μ long. Mucronate hyphopodia mostly opposite, ampuliform, 15 μ long. Mycelial setae absent. Perithecial setae few, usually but one on a perithecium, straight, obtuse, 40–55 μ long. Perithecia spherical, rough, black, 150–160 μ in diameter. Asci evanescent. Ascospores brown, 4-septate, obtuse, 32 × 12 μ. (PL. 2, FIG. 28.)

Group No. 3401–3220.

On *Sida* sp.

BRITISH GUIANA: Rockstone, July 17, 1922, No. *478* (type).

This species, which is entirely distinct from the three species thus far recorded on *Sida*, falls next to *M. aciculosa* Wint. in the Beeli key. It is particularly remarkable because of the frequent occurrence of a single seta on the perithecia, which are otherwise quite glabrous.

31. **Irene Marcgraviae** (Tehon) Stevens & Tehon, n. comb.
Meliola Marcgraviae Tehon, Bot. Gaz. **67**: 506. 1919.
On *Marcgravia* sp.
BRITISH GUIANA: Tumatumari, July 10, 1922, No. *110*.

EXPLANATION OF PLATES 1 AND 2

Figs. 1–22. *Meliola* spp. (*a*, mycelium; *b*, setae; *c*, spores)

1. *M. Aristolochiae;* 2. *M. Coccolobis;* 3. *M. angusta;* 4. *M. varicuspis;* 5. *M. Meibomiae, d,* perithecium; 6. *M. conigera;* 7. *M. trinidadensis, d,* dividing hyphopodium; 8. *M. Pithecolobii, d,* subiculum; 9. *M. byrsonimicola;* 10. *M. byrsonimina;* 11. *M. Manihot;* 12. *M. Euphorbiae;* 13. *M. Alchorneae;* 14. *M. Tapirirae;* 15. *M. tapiriricola, d,* subiculum; 16. *M. serjaniicola;* 17. *M. rhamnicola;* 18. *M. olecranonis, d,* perithecium; 19. *M. Lisianthi, d,* perithecium; 20. *M. gnathonella;* 21. *M. amphigena;* 22. *M. Malaneae.*

Figs. 23–28. *Irene* spp. (*a*, mycelium; *b*, spores; *c*, perithecium)

23. *I. cubitella;* 24. *I. cubitorum;* 25. *I. Ingae;* 26. *I. Crotonis;* 27. *I. Alchorneae;* 28. *I. sidicola.*

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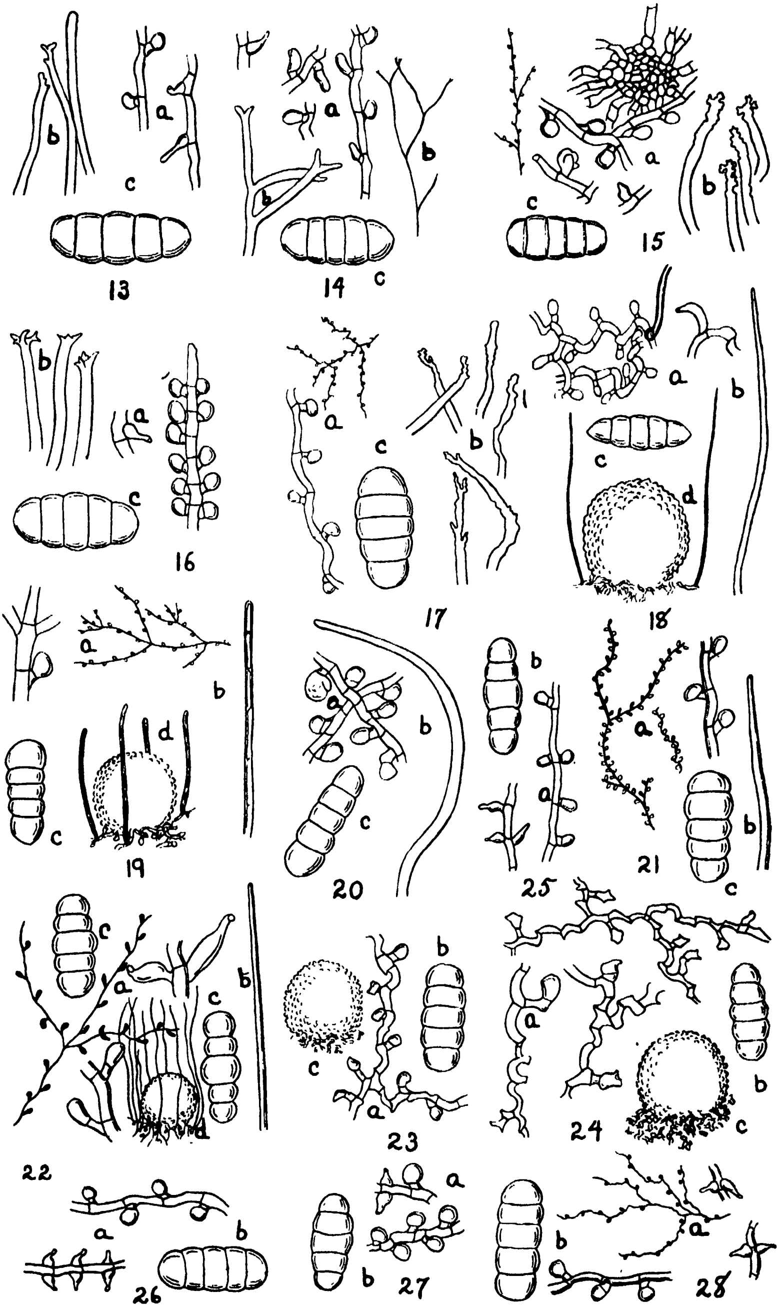


MELIOLA AND IRENE

THE NUMBER AND ARRANGEMENT OF FLAGELLA OF THE FIRE BLIGHT PATHOGEN, BACILLUS AMYLOVORUS

H. R. ROSEN

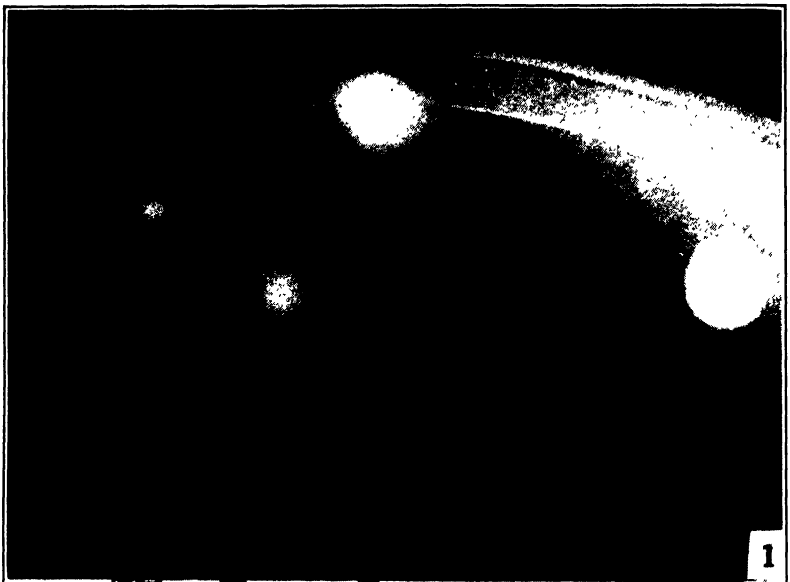
(WITH PLATES 3 AND 4)

In the early part of the summer of 1924 and again in 1925, the writer isolated bacteria from apples which had shown typical symptoms of fire blight. Not only the fruit but the spurs, twigs, and leaves all indicated this disease. The isolations, beginning with a series of 10 poured plates, resulted in apparently pure cultures of *Bacillus amylovorus*. Growth on nutrient agar, broth, milk, and other media all compared with written descriptions of this organism (PL. 3, FIG. 1). However, when transfers of these were subjected to a flagella stain, developed by the writer, the organisms instead of showing numerous peritrichiate flagella showed only single, polar flagella. As the fire blight organism has been known for many years and apparently has been well worked out, the writer, not having any green apples or pears available at the time of the first isolation (this was in July, 1924), assumed that the isolated organism was not *B. amylovorus*.

To my surprise, the organism isolated the second time, May, 1925, while otherwise showing characteristics of *B. amylovorus* like the 1924 isolation, also showed rods with only single, polar flagella. Infection experiments were immediately undertaken. Six green pears were inoculated by means of needle punctures, the needle carrying a pure culture, while five others, wounded in a similar fashion but not inoculated, served as checks. All were then placed in a moist chamber. Within 48 hours typical, blackish spots appeared in all the inoculated fruit, around the needle punctures, while all the checks remained sound. In a few days the rotted areas showed creamy-white droplets exactly comparable to the bacterial ooze of blighted fruit resulting from natural infection. All the checks remained healthy (PL. 3, FIG. 2). From one of the inoculated pears, the organism was recovered by ordinary surface sterilization, dilution method, and used for another series of inoculations upon green pears, using an adequate number of fruits as checks. Again, all inoculated fruit became infected, while checks remained healthy (PL. 4, FIG. 1). Five succulent, pear water-sprouts were then inoculated by means of hypodermic injections, while 5 others were comparably wounded by a sterile, hypodermic needle but not inoculated. The cut ends of the twigs were placed in battery jars containing water, and the whole then covered with bell jars. After several days the inoculated twigs showed a severe blighting at the tips while the wounded checks, though showing from 1 to 3 blackened leaves, did not develop any comparable blight. (Presumably the wounding was responsible for the damage in the checks.) The evidence thus appears substantial that the true fire blight germ was involved.

Now, numerous investigators, including Dr. Erwin F. Smith, have reported the causal organism of fire blight as a peritrichiate rod. Indeed, the generic name, *Bacillus*, has been applied to it primarily because it was supposed to possess a number of flagella arranged around the rod. Smith (Bacterial Diseases of Plants, fig. 291, p. 377) presents a microphotograph showing the organism, presumably with several peritrichiate flagella (PL. 4, FIG. 3). As the various preparations which I have made for the two different isolations and for the one reisolation all show rods with but single, polar flagella (PL. 4, FIG. 3), one wonders what the explanation for this discrepancy may be. There are at least three possible explanations for this. First, that different species are involved and that either the one here considered, or the one considered by other investigators, is not representative of the true pathogen. Second, that there exist different strains of the same species, varying in the number and arrangement of flagella. Third, that difference in flagella staining methods may account for the apparent discrepancy.

I am inclined to favor the third, and for this reason. In most of the preparations made by the older flagella staining methods, such as van Ermengem's or Loeffer's, the bodies are considerably distorted and out of proportion, and there is apt to appear a more or less heavy precipitate on and around the organisms. These



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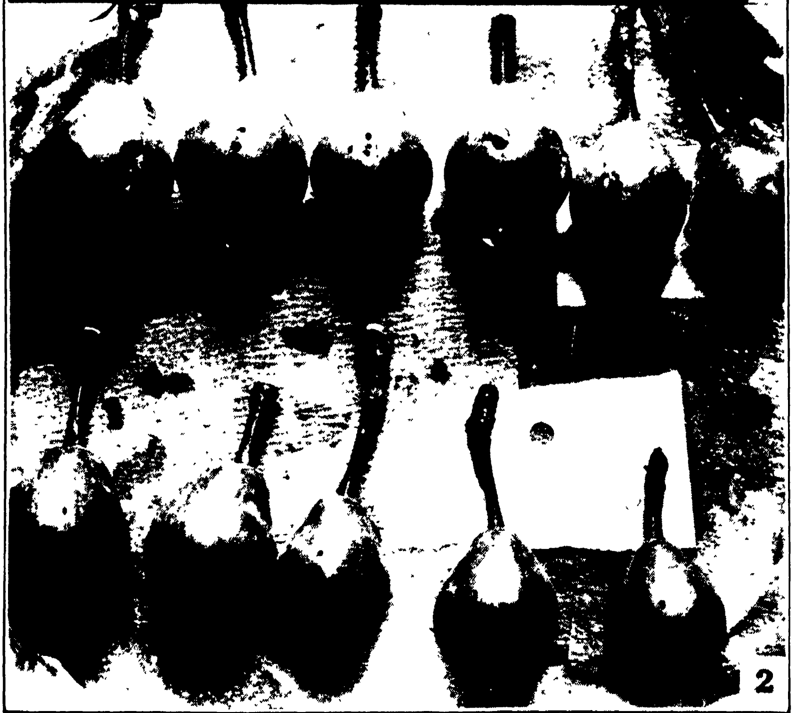

2

Bacillus amylovorus

features often make it impossible to tell whether a given figure represents one rod or a group of rods. Dr. Smith's photograph, noted above, I believe is open to this criticism. While the flagella are heavily stained and well reproduced, the shape, size, and outlines of the bodies are quite indefinite.

In view of the long established name of the causal organism of fire blight, I am reluctant to offer any change in the name, at least not until other investigators have had an opportunity of re-examining *B. amylovorus* and reporting their results.[1] In the meantime, it may be well to bear in mind that the generic name, *Bacillus*, will not be tenable should it be confirmed that the organism has only a single polar flagellum. If Migula's nomenclature is followed, the name *Pseudomonas amylovorus* will be applied, or if Dr. Smith's system is followed, *Bacterium amylovorus* will be proper. The recent suggestions of name changing sponsored by the Society of American Bacteriologists (Bergey's Manual of Determinative Bacteriology, 1923) have not as yet met with favor among plant pathologists. A committee representing the bacteriologists has taken up the generic name *Erwinia*, first proposed by them in 1917, in which they place all plant pathogens possessing peritrichiate flagella. Unfortunately they have chosen for the type species *Bacillus amylovorus*, giving it the name *Erwinia amylovora*. If my findings are correct, then it will have to be placed in their new genus *Phytomonas*.[2]

UNIVERSITY OF ARKANSAS,
FAYETTEVILLE, ARKANSAS.

EXPLANATION OF PLATES

PLATE 3

Fig. 1. Colonies on nutrient agar, poured plates, several days old. Note the irregular, fuzzy margin of the buried colonies. (See Smith's Bacterial Diseases of Plants, pp. 369–370.) Slightly enlarged.

Fig. 2. Top row—6 pears inoculated by means of needle pricks with *B. amylovorus*. Photographed 4 days after inoculation. Note the bacterial ooze appearing in several of the inoculation centers.

Bottom row—checks, wounded but not inoculated.

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[1] The flagella staining method developed by the writer will shortly be ready for publication.

[2] What a pity that some agreement cannot be had among plant pathologists and bacteriologists on the use of generic names!

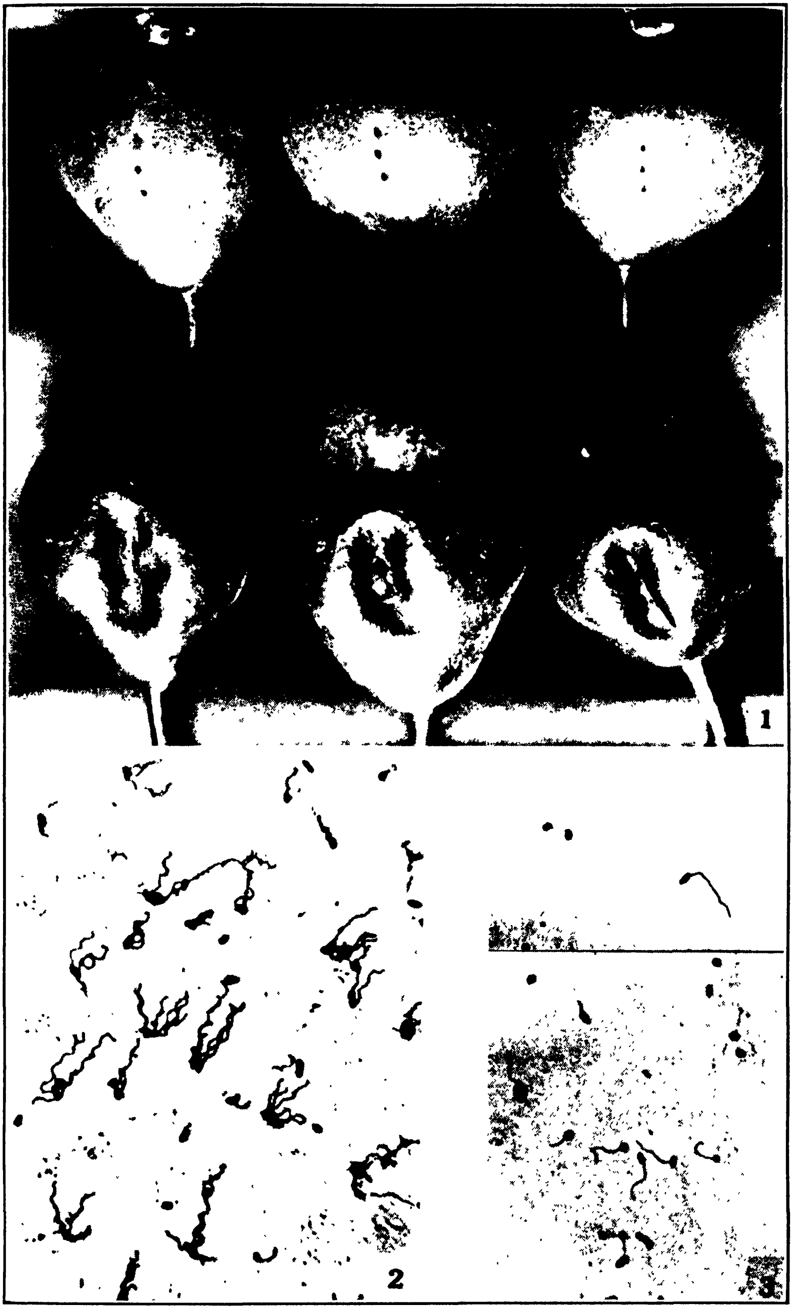
PLATE 4

Fig. 1. Bottom row—inoculated with a reisolation from one of the infected pears shown in pl. 3, fig. 2. Absence of ooze and the depression of the pears in the infected regions is due to drying out of chambers.

Top row—checks.

Fig. 2. *Bacillus amylovorus* after Erwin F. Smith (Bacterial Diseases of Plants, fig. 291, p. 377). Note the variation in size and in outline of the bodies of the bacteria. Magnified about 1000 times.

Fig. 3. *B. amylovorus* stained by a method developed by the writer. Magnified about 1000 times. Wherever more than one flagellum appeared, careful examination always revealed more than one organism.



BACILLUS AMYLOVORUS

POLYPORUS ANCEPS AND POLYPORUS IMMITIS *

C. H. Kauffman

(With Plate 5)

Among the white polypores named by Peck, the two species *P. anceps* Peck and *P. immitis* Peck are probably the least known, partly because of their rarity, partly because they have been thrown into synonymy by recent students of the Polyporaceae. It was natural to look for *P. anceps* on hemlock, the wood on which it was collected by Dr. Burt and given as the host in Peck's account. Occasionally I have run across a white *Polyporus* growing on coniferous wood, a plant which clearly did not belong to any of the white species now fairly well known as growing on conifers. Until within the last half dozen years I had no suspicion that these might belong to *Polyporus anceps*. After the idea had suggested itself, however, I studied collections more carefully and am strongly inclined to think that my plants belong to that species. Recently I obtained photographs from two such collections, one collected near Ann Arbor, Michigan, on tamarack, the other from Elkmont, Tennessee, on pine. There is no "a priori" reason that I can see, why this species should be limited to hemlock.

Weir (6) has referred a western plant growing on *Larix* and on *Pinus* to Dr. Peck's species. This western polypore is white, but tends to become reddish or sordid stained in age, and as Lloyd (1) well remarks, Peck's plants are white and remain white or whitish. Through the kindness of the Office of Forest Pathology at Washington, D. C., I was able to examine some of these western collections. The specimens, however, to which I have assigned the name of *P. anceps* were white when fresh, or showed only slight traces of yellowish where bruised either on the edge of the pileus or on the pore mouths. They dry white

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* Papers from the Department of Botany of the University of Michigan, No. 237.

"in situ," or remain white in the herbarium. I append the following description drawn from the Michigan and Tennessee collections:

Resupinate-reflexed, usually vertically extended lengthwise of trunks or stumps, resupinate between the reflexed pilei, or pilei connate behind or subimbricate; pilei narrowly dimidiate, 3–7 cm. wide, 1–3 cm. long, *i.e.*, laterally elongated or subconfluent, milk-white to dull white, unchanging; surface minutely downy, glabrescent, uneven with small tubercles or rugosely pitted or slightly scrupose, sometimes concentrically subsulcate near the margin; margin obtuse, rather abrupt, slightly lutescent where bruised when fresh; context *subcoriaceous*, *Trametes*-like, but pulling off from tube-layer, white or whitish, relatively thin, 1–5 mm. radially tough-fibrous; tubes 4–8 (10) mm. long when well developed, white, decurrent, reaching the abrupt margin of the pileus; pores small, 3 per millimeter, circular, dissepiments obtuse, occasionally slightly yellowish stained where bruised; spores hyaline, oblong, 7–8 (9) × 3–3.5 μ: basidia 4-spored; cystidia none. (PLATE 5.)

When well developed, the fruit body covers much more of the vertical surface of the substratum than did the specimens from which Peck drew his description (**4**); such plants are hardly comparable to the traditional concept which is usually held of *P. semisupinus* and *P. semipileatus*, with which Peck compares his plant. It is reasonable to suppose that the species was described from specimens which were not very fully developed. This is probably the reason that Peck gave no spores characters with his account.

Polyporus immitis (see Peck, **5**) has been reduced to synonymy under *P. galactinus* Berk. both by Murrill (**2**) and by Overholts (**3**). This is not surprising, because the two plants frequently are extremely alike in most of their characters. There are, however, some fundamental differences. I have studied with great care a number of fresh and thoroughly typical collections of *P. galactinus* during the past years, and the spores of this species when in good condition and abundant are subglobose to oval, measuring on an average 4 × 3 μ, or if one follows the ordinary usage, the variation is best expressed by the size 3–4.5 × 2.7–3.5 μ.

Immature spores, often abundant in a mount, will of course, if included, disturb the above measurement; only fresh, mature and therefore turgid spores should be taken into account. In contrast to this, the spores of *P. immitis*, as I know it, are truly oblong, narrow, and measure 3.5–5 × 1.5–1.8 μ, rarely 2 μ thick; both have 4-spored basidia.

The other main distinction between these two species is in the character of the context. In *P. galactinus* the context is duplex, and the species falls naturally in the *Spongipellis* group as given in the North American Flora. However, the thickness of the upper layer is externally variable, and fresh plants may show this layer quite prominently with a thickness of 2 to 3 mm., while others show only a thin tomentose surface scarcely recognizable as a layer. In *P. immitis* there is no upper horizontally differentiated layer, the tuberculose surface being due to small extensions of bundles of fibres growing radially to the surface. The odor of *P. immitis* is aromatic, or may be called a sweet acid odor; but there is no distinction here that could be used to distinguish it from *P. galactinus*, which has a very similar odor. Both are really fragrant when collected in good growing condition.

In practically all other characters the two species are very similar; in size, habit, color, length of tubes and pore size the two are indistinguishable. In the dried condition also, there is great similarity. My studies of *P. immitis* were made from two collections; one from Quincy, Michigan, on an ash log, the other from Seventh Lake, Adirondack Mountains, New York, on a yellow birch log. The latter plants attracted my attention by general features only; they had much the appearance of *P. galactinus* which was rather frequent in that region, and until I examined the spores I thought it simply a case of variability of the latter species. The fact that Peck reported it only on *Fraxinus* doubtless has had its share in the neglect which the species has received. Professor Athinson, however, collected it both at Ithaca and in the Adirondacks.

In conclusion, I wish to point out that the zonation of the context in *P. galactinus* is more variable than is usually supposed. Fresh plants may show scarcely any zonation, but on losing moisture or after being dried, the zoned condition becomes quite marked. In *P. immitis* zonation was very inconspicuous in the fresh plants.

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ANN ARBOR, MICHIGAN.

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3. **Overholts, L. O.** The Polyporaceae of the middle-western United States. Wash. Univ. Studies **3**: 52. 1915.
4. **Peck, C. H.** New species of fungi. Bull. Torrey Club **22**: 207. 1895.
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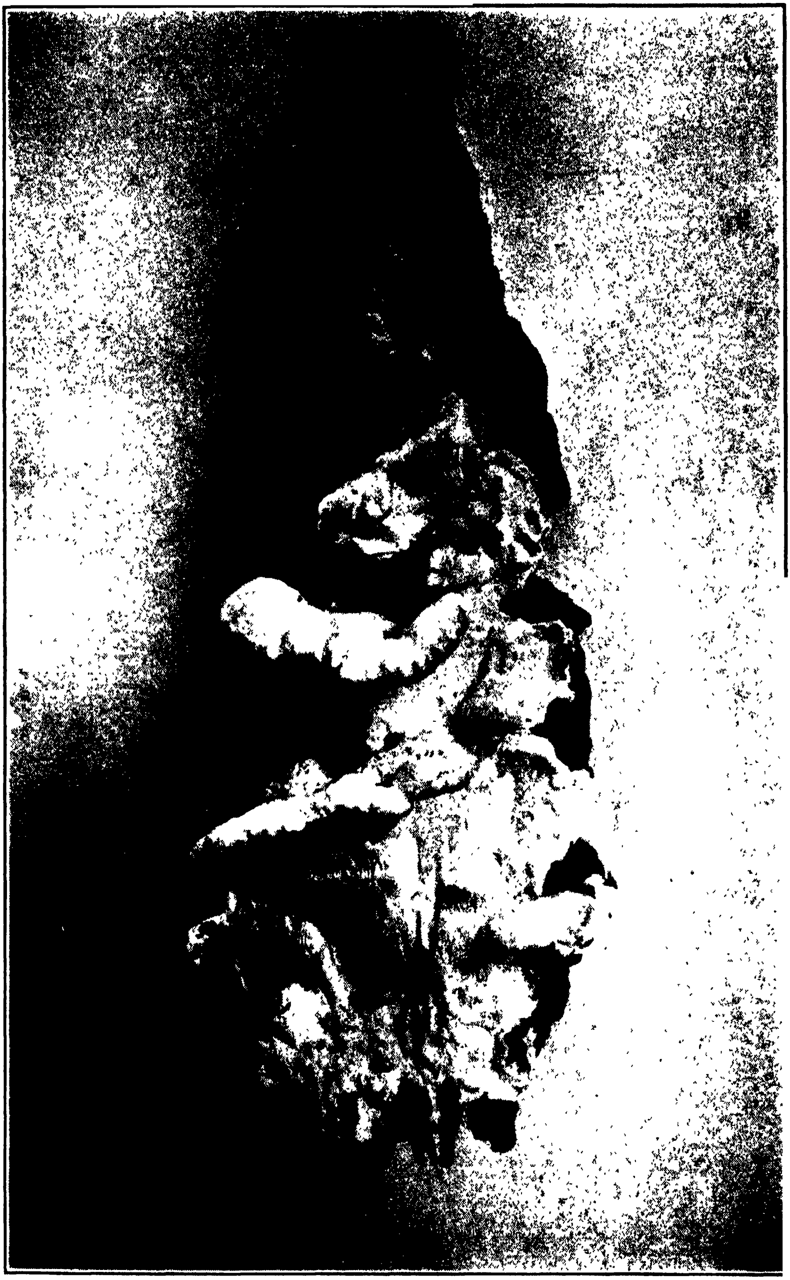
6. **Weir, J. R.** Montana forest tree fungi. Mycologia **9**: 132. 1917.



POLYPORUS ANCEPS Peck.

MYCOLOGICAL NOTES FOR 1924[1]

L. O. OVERHOLTS

(WITH PLATE 6 AND 2 TEXT FIGURES)

1. CERCOSPORA BOEHMERIAE Peck.

Collected at Charter Oak, Huntingdon County, Pa., on *Boehmeria cylindrica*, fruiting on the lower surface of conspicuous brown areas. Peck describes the spots as numerous and minute, and the spores as 40–90 μ long. In my collection the spots are usually about 5 mm. broad, but sometimes twice that size, and the spores 40–126 × 3–4 μ. Under the microscope the spores are practically colorless or very dilutely colored. Professor Dearness has verified this determination.

2. CLADOSPORIUM CUCUMERINUM Ellis & Arth.

This fungous parasite of the fruits of the cucumber (*Cucumis sativa*) seems not to have been often noted in the United States since its original discovery in 1889 (Bull. Agr. Exp. Sta. Ind. **19**: 8–10. 1889). It was sent in from Curtin, Pa., in October of the present year, and was evidently causing considerable damage. The exudation of a gummy amber-colored substance as noted both in the original account and in the description in Rabenhorst was well marked on my specimens. I find no conidiophores of the type illustrated by Humphrey who found the disease in Massachusetts in 1892 (Rep. Mass. Exp. Sta. **10**: 231. 1892). My spore records are 7–16 × 4–6 μ. The fungus is said to occur also on the leaves.

3. GLOEOSPORIUM CORYLI (Desm.) Sacc.

When this fungus was first collected in 1919 it was referred to *Leptothyrium Coryli* Lib. This year it was again collected on

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[1] These notes on new and little known fungi are a continuation of similar short papers begun in 1919 and published for that year in Mycologia **12**: 135–142. 1920; for the year 1920 in Bull. Torrey Club **49**: 163–173. 1922; for the year 1923 in Mycologia **17**: 108–112. 1925.

Contribution from the Department of Botany, The Pennsylvania State College, No. 52. Published by permission of the Director of the Agricultural Experiment Station.

leaves of both *Corylus rostrata* and *C. americana*, on the former host at Plainfield, Vt., and on the latter at Charter Oak, Pa. The fungus fruits rather abundantly on large, brown, conspicuous, though indefinite spots on the upper surface of the leaves. The fruiting body in young stages has the appearance of a dimidiate pycnidium. The nature of the black overlying wall is difficult to make out though it is usually quite conspicuous. It seems, however, not to be composed of fungous hyphae, but rather is the cuticle of the host blackened by the fungus. There is little doubt that these two species, though described independently, are in reality the same plant and best referable to *Gloeosporium*. The spores are oblong, hyaline, 10–15 × 4.5–6.5 μ. The fungus is definitely subcuticular in its origin. (PL. 6, FIG. 2, 3.)

4. MARSSONIA QUERCINA Wint.

Material of an anthracnose on *Quercus velutina* was collected at Charter Oak, Pa., during the season. When examined it was found to have *Marssonia*-like spores 15–27 × 2–2.5 μ, in epiphyllous acervuli, one to six on each small spot 1–4 mm. diameter. *M. Martini* Ellis & Ev., our most common species on *Quercus*, has hypophyllous acervuli with spores 12–15 μ long. Professor Dearness refers the specimen to *Gloeosporium septorioides* Sacc. var. *major* Ellis & Ev. and indicates *Marssonia quercina* Wint. as a possible synonym. Since in my collection the spores are definitely 2-celled with a conspicuous septum, I have filed it as *Marssonia quercina* var. *major* Ellis & Ev.

5. MONOCHAETIA TAPHRINICOLA (Ellis & Ev.) Sacc.

This year for the first time, in my experience, the lower surfaces of the deformed leaf areas caused by *Taphrina coerulescens* became blackish in color due to the development of the above species. The injury to the leaves seemed to be much extended over that produced by the *Taphrina* alone, so that large dead areas developed, sometimes affecting the entire leaf. The spores of the *Monochaetia* measure 18–21 × 6 μ. The effect of these two fungi was particularly severe in central Pennsylvania on *Quercus rubra*.

6. PHYLLOSTICTA CONFERTISSIMA Ellis & Ev.

This species was abundant this season in the same locality mentioned in my last report, namely, Charter Oak, Pa. A large number of small trees of *Ulmus americana* were found heavily infected so that many leaves were dropped early. Careful search was made for it on *Ulmus fulva* but without avail. In one spot there was discovered in mid-October an American elm with some infected leaves and within 10 feet of it a tree of *U. fulva* entirely free from infection. The fungus does not fruit until the leaves, or at least the leaf margins, begin to die and become brittle, and in no case does it appear to fruit before September.

7. PHYLLOSTICTA LAPPAE Sacc.

This species was collected on *Arctium* in Tioga County in northern Pennsylvania during the season. Seaver (N. Am. Fl. **6**: 32. 1922) records it only from Ohio and Ontario. Spores 6–9 × 2.5–3.5 μ.

8. SEPTORIA CORNI-MARIS Sacc.

The common *Septoria* spot of *Cornus* is caused by *S. cornicola*, while *S. canadensis* is occasionally found. Both have multiseptate spores 30–60 μ long. In this as well as in the character of the spots produced, two of my collections on *Cornus florida* from central Pennsylvania are entirely different. The spores here are 13–27 × 2–2.5 μ and 1- to 3-septate, and if one may judge from the description, the plant is otherwise sufficiently close to *S. Corni-maris* Sacc. to be referred to that species. No specimens are available for comparison and I have seen no record of the occurrence of this species in America.

9. COCCOMYCES LUTESCENS Higgins[2]

I have seen no confirmation in the literature of certain phases of the work of Higgins on the *Cylindrosporium* spot of stone fruits.

During the past year I examined sections through the fruiting body of a *Cylindrosporium* collected at Walden, Vt., on *Prunus serotina*. According to the ideas of Higgins as set forth in the paper cited, this should be *C. lutescens*. The material showed the usual macroconidia, the microconidia described by Higgins, and the early stages in the development of the ascigerous stage. The first mentioned stage showed the usual characteristics assigned to the old *Cylindrosporium Padi* but in my sections I could not make out a definite stromatal layer to the hymenium as described by Higgins. The microconidial stage with bacilliform spores about 4 × 1 μ, in every case developed as an acervulus external to the internal stromatic mass, I judge will later develop into the ascocarp. Higgins relates that the microconidia seem to be produced from the same conidiophores as the macroconidia, but in no case did my preparations indicate this to be true. On the contrary they would seem to have been developed *de novo* with no relation to the other acervuli. It would appear that the ascigerous stromatal layer in the mesophyll of the leaf is developed about simultaneously with the microconidial acervulus just beneath the epidermis. There is a narrow zone of brown disintegrated host tissue separating these two bodies in nearly every instance. That macroconidia have not preceded the microconidia in the same acervuli seems clear not only from the fact that the microconidial acervuli are more superficial than the macroconidial ones and are considerably smaller as well, but also because I have seen numerous instances where the former are yet covered by the intact epidermis of the leaf though filled with the minute spores. Such could scarcely be the case if the pustule had originally produced the larger spores since in an acervulus at any stage of near maturity the epidermis is either pushed off or else breaks or tears when the section knife strikes it.

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[2] HIGGINS, B. B. Contribution to the life history and physiology of *Cylindrosporium* on stone fruits. Am. Jour. Bot. **1**: 145–173. 1914.

10. GNOMONIA RUBI Rehm.

In a large bramble patch of *Rubus allegheniensis* at Greensboro Bend, Vt., in August, the canes seemed to be dying out to a considerable extent. Search at the time failed to show that more than a small percentage of the death was caused by any of the usual bramble parasites. Later study of the material showed the presence of a fungus that seems identical with the above species as described by Edgerton (Bull. Torrey Club **34**: 593. 1907). This is the only record of the fungus I have seen in the

American literature. The spores seem often to be 4-celled, though perhaps falsely so due to the prominent oil globules in the lumen. They are produced 4 per ascus and measure 12–15 × 2.5–3 μ. (PL. 6, FIG. 1.) The extent of the parasitism of this fungus has not been determined in America.

11. PYRENOPEZIZA RUBI Rehm.

A species so referred by Professor Dearness was collected at the same time as *Gnomonia Rubi* at Greensboro Bend, Vt., and on the same host. My spore measurement records were 15–24 × 2 μ, considerably longer than reported by Rabenhorst (7–9 × 1.5–2.5 μ). (PL. 6, FIG. 4.)

12. RHYTISMA PUNCTATA (Pers.) Fr.

The usual hosts for this fungus are *Acer pennsylvanicum* and *A. spicatum* in central Pennsylvania. On both of these hosts it develops abundantly and as the leaves turn yellow in preparation for leaf fall the appearance this fungus presents is indeed striking. The chlorophyll remains in the infected area after it has disappeared from the surrounding tissue, so that the yellow of the general leaf tissue contrasts strongly with the green of the infected tissue and the black of the numerous gregarious fruiting bodies. This year the fungus was collected in quantity on *Acer Saccharum* at Charter Oak, Pa. I have never found it on *A. rubrum* though this species grows with both *A. spicatum* and *A. pennsylvanicum.* Even when these hosts grow side by side no infections have been found on *A. rubrum.*

13. TAPHRINA FILICINA Rost.

A collection on *Onoclea sensibilis* made near State College, Pa., in 1921 seems referable here and is noteworthy as the first report of a *Taphrina* or an *Exoascus* on *Onoclea*, outside of a little known occidental species recently described.

This species differs from collections on *Polystichum* previously referred to *T. lutescens* in having smaller asci and smaller spores, though Professor Dearness writes me that he has specimens of that species determined by Dr. Farlow with measurements about those of my collection, viz. 4–5 × 1.5–2 μ.

The following notes were made on this collection:

Spots elongate or irregular, the leaves not at all distorted, rusty-yellow, eventually the entire leaf assuming this color, visible from both surfaces, 2–3 × 0.5–2 mm., usually limited by the veinlets; hymenium hypophyllous, consisting of a continuous palisade of asci 21–30 μ long, 8-spored; spores narrow elliptic or fusoid, hyaline, 1-celled, 4–5 × 1.5–2 μ.

On fronds of *Onoclea sensibilis.*

The spots have the appearance of those caused by *Uredinopsis* on the same host. The asci are much shorter than those of *T. lutescens.*

14. POLYPORUS BETULINUS (Bull.) Fr.

Mr. C. R. Stillinger sends me this species from Metalline Falls, Wash., on *Betula papyrifera.* This is the first time this species has been recorded from west of Minnesota with the single exception of Weir's record from Montana.

15. PORIA SEMITINCTA (Peck) Cooke.

Since my first review of this species (N. Y. State Mus. Bull. **205–206**: 106–108. 1919) I have received and collected nearly twenty additional collections, showing it to be of rather common occurrence from Pennsylvania to North Carolina and west to Kentucky and Wisconsin. As previously described, clamp connections are usually absent, but as is probably true in most such cases, prolonged search will reveal a few such connections, at least in some parts of the fructification. In one collection from Asheville, N. C., I find a few rather prominent clamps and in a few cases clamps on two opposite sides of a hypha at the same septum, as shown in the illustration. This is the first time I

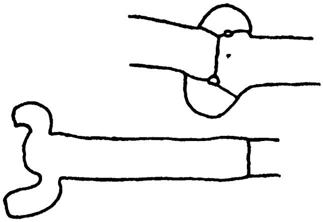


FIG. 1. *Poria semitincta.* Double clamp connections on the hyphae.

have seen this phenomenon, though I am of the opinion I have seen reference to it previously.

WITCHES BROOMS ON PRUNUS, ACER, AND PICEA

At Greensboro, Vt., a witches broom was found developing abundantly on *Prunus pennsylvanica* in August, 1925. Owing to the lateness of the season the brooms were largely defoliated and an exact determination of the causal fungus was impossible, but probably should be referred to *Taphrina Cerasi* (Fuckel) Sadebeck.

At State College, Pa., there has been noted for many years a broom on *Acer platanoides*. This year the broom was cut out in pruning the tree and the accompanying photograph secured (TEXT FIG. 2). No identification of the causal organism was made.

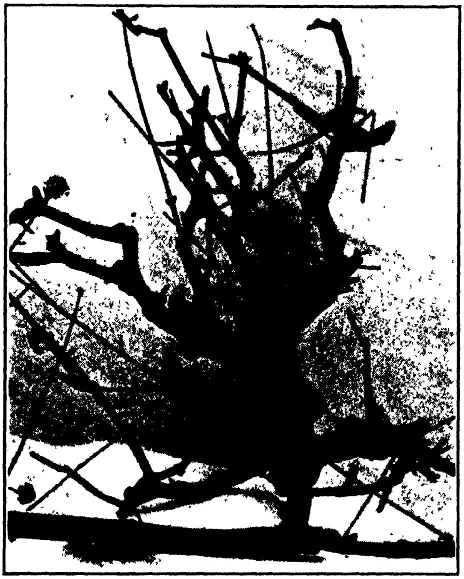


FIG. 2. Witches broom on *Acer plantanoides*. Greatly reduced.

In the little town of Beallsville, situated on the National Pike between Brownsville and Washington, Washington County, Pa., there may be seen an excellently developed broom on

Norway Spruce (*Picea excelsa*). No conjecture can be made as to the agency responsible for this broom, but the rarity of the occurrence of brooms on both *Acer* and *Picea* seems to render worth while this note of their occurrence.

17. CINTRACTIA JUNCI (Schw.) Trelease.

The fungus recorded in my 1923 Notes under the above name from Colorado is, I find, not that species but *Cintractia Caricis* (Pers.) Magn., and is on a filiform-leaved *Carex*, and not on *Juncus*.

PENNSYLVANIA STATE COLLEGE,
STATE COLLEGE, PA.

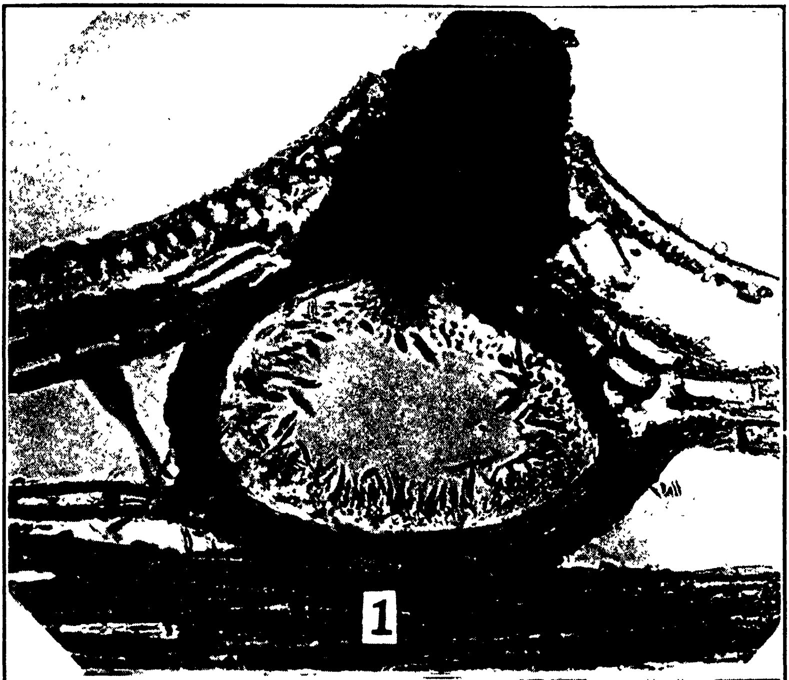
EXPLANATION OF PLATE 6

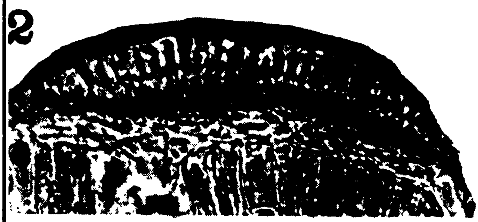
Fig. 1. Microphoto of free-hand vertical section through the perithecium of *Gnomonia Rubi*. × 220. Overholts Herb. *9411*.

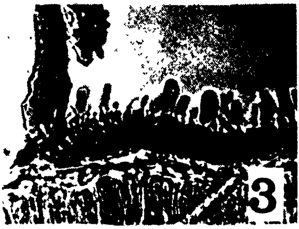
Fig. 2. Microphoto of free-hand section through an acervulus of *Gloeosporium Coryli*, showing the unbroken cuticular covering. × 353. Overholts Herb. *9425*.

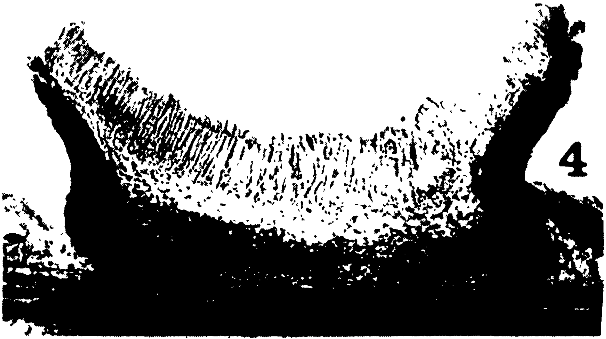
Fig. 3. Microphoto of free-hand sections of a portion of the acervulus with the covering torn off, and showing spores in position. × 820. Overholts Herb. *9425*.

Fig. 4. Microphoto of free-hand vertical section of apothecium of *Pyrenopeziza Rubi*. × 150. Overholts Herb. *9413*.









1. GNOMONIA RUBI
2, 3. GLOEOSPORIUM CORYLI
4. PYRENOPEZIZA RUBI

SOME NEW AND INTERESTING PORTO RICAN RUSTS

FRANK D. KERN AND H. H. WHETZEL

During the months of June and July, 1924, the writers visited Porto Rico on invitation of the Commissioner of Agriculture, Hon. Carlos E. Chardon, to assist in studies on the parasitic fungi of the Island. About 850 collections of fungi were brought back, all from Porto Rico except about 75 which were taken in Vieques, a small island lying off the east coast.

In making and studying these collections special attention has been given to the rusts. Numerous previous collectors, among whom may be mentioned Clinton (1904), Holway (1911), Whetzel and Olive (1916), Stevens (1913 and 1915), and Seaver and Chardon (1923), have furnished a basis for fairly extensive studies of the rusts of this island.

The rust flora of Porto Rico is better known than that of any other of the West Indian Islands. It is not a matter of surprise, therefore, that the great majority of the specimens collected during our comparatively brief exploration should be readily referable to previously recorded species. In our explorations made in 1924 the writers were accompanied on all collecting trips by Mr. R. A. Toro, assistant plant pathologist of the Insular Experiment Station at Rio Piedras. Commissioner Chardon was also with us on a number of the trips. Much credit for the success of the undertaking is due to Commissioner Chardon and to Mr. Toro. Their knowledge both of localities and of the native vegetation was of very material aid.

In addition to our collections there have been placed in our hands an extensive undetermined set of collections made in Porto Rico by Fred J. Seaver and Carlos E. Chardon, January 24 to April 5, 1923; a small set collected by G. P. Clinton in April 1904 and the private collections of C. M. Tucker, pathologist of the Federal Experiment Station at Mayaguez. These specimens have been studied in connection with our own and some of them are discussed in the notes presented here.

In making our studies two papers by Dr. J. C. Arthur, Uredinales of Porto Rico, based on collections by F. L. Stevens (MYCOLOGIA **7**: 168–196, 227–255, 315–332. 1915; **8**: 16–33. 1916) and Uredinales of Porto Rico, based on collections by H. H. Whetzel and E. W. Olive (MYCOLOGIA **9**: 55–104. 1917), have been indispensable. We are also indebted to Dr. Arthur for suggestions and critical advice; to Professor H. S. Jackson of the Botany Department, Purdue University Agricultural Experiment Station, for access to the Arthur Herbarium, assistance in determining specimens and other courtesies; and to Dr. N. L. Britton, of the New York Botanical Garden, for determination of all the hosts.

UREDO

Uredo Campeliae sp. nov.

Uredinia chiefly hypophyllous, scattered, small, roundish or oval, 0.2–0.4 mm. across, rather long, covered by the epidermis, dingy yellow; urediniospores broadly ellipsoid, 22–27 × 29–32 μ, the wall pale yellow or colorless, thin, about 1.5 μ, sparsely and strongly echinulate with points 2–3 μ apart, the pores 2, equatorial.

On COMMELINACEAE:

Campelia Zanonia (L.) H.B.K. Hacienda Limon, near Villalba, July 14, 1924, *Whetzel, Kern & Toro 2475.*

This species differs from *Uromyces Commelinae*, *Puccinia Commelinae*, and *Uredo ochracea*, all of which occur on the same host family, in having pale yellow or colorless spores instead of brownish ones. It resembles *Uredo Commelyneae* in having colorless spore-walls but differs in the wall markings being sparsely and prominently echinulate instead of finely echinulate or verrucose-echinulate. The sori are noticeably whitish.

Uredo Rousseliae sp. nov.

Uredinia hypophyllous, numerous, scattered or crowded in small irregular groups, small, 0.1–0.2 mm. across, with imbricated incurved paraphyses united at their bases forming a pseudoperidium opening by a central pore, pale brown; urediniospores broadly ellipsoid, 16–19 × 20–27 μ, the wall colorless, thin, 1–1.5 μ, finely and closely verrucose, the pores obscure.

On URTICACEAE:

Rousselia humilis (Sw.) Urban. Hacienda Limon, near Villalba, July 14, 1924, *Whetzel, Kern & Toro 2476.*

We have not found any species on the family Urticaceae at all comparable with this. Records of South American forms have been given special attention. The uredinia here described are of the *Cerotelium* or *Phakopsora* type as outlined for those genera by Arthur (Bull. Torrey Club **44**: 501–511. 1917), but they are not identical with any of the known species in these genera. The hemispherical pseudoperidium with the small central ostiole is characteristic.

Uredo Buchenaviae sp. nov.

Uredinia hypophyllous, few, scattered, very small, 0.1 mm. or less across, without peridium or paraphyses, long covered with the epidermis, punctiform, light yellowish-brown; urediniospores broadly ellipsoid or obovoid, often angular, 16–23 × 23–29 μ, the wall pale cinnamon-brown, 1–15 μ thick, moderately echinulate, the pores obscure, probably 2, equatorial.

On TERMINALIACEAE:

Buchenavia capitata (Vahl) Eichl. Reservoir road, near Guaynabo, June 23, 1924, *Whetzel, Kern & Toro 2477.*

We have found a report of but one rust on the family Terminaliaceae. P. Henning described *Uredo Byrsonimatis* on *Terminalia argentea* under the impression that his host was a *Byrsonima.* Later in correcting his error he proposed the name *U. Terminaliae* P. Henn. (Hedwigia **34**: 98 and 321. 1895). We have examined a part of the original specimen of the Henning species which was collected in Brazil by E. Ule. It differs from our specimen in having slightly larger spores, with paler, thicker walls, and with 4 or 5 evident equatorial germ pores. Our species is so very inconspicuous as to be easily overlooked.

Uredo guaynabensis sp. nov.

Uredinia hypophyllous, scattered, roundish or oval, 0.2–0.4 mm. across, tardily naked, light chestnut-brown; urediniospores broadly ellipsoid or obovoid, often more or less irregular or angular, 18–23 × 24–32 μ (occasionally up to 37 μ long), the wall thin, about 1 μ, golden-brown, moderately echinulate, the pores 2, equatorial or superequatorial.

On ONAGRACEAE:

Jussiaea angustifolia Lam. (*J. suffruticosa* Authors not L.). Demonstration Farm, near Guaynabo, June 25, 1924, *Whetzel, Kern & Toro 2478*. (Also on *J. peruviana* L. from Isle of Pines, and *Jussiaea angustifolia* Lam. from Jamaica—see following note.)

Up to the present time no rust on *Jussiaea* has been described with a uredinial stage. On our material we find only uredinia. In his paper on "The Uredinales found upon Onagraceae" Bisby (Am. Jour. Bot. **3**: 555. 1916) mentions a phanerogamic specimen, *Jussiaea* sp., collected by N. L. Britton, marsh land near Ferry River, vicinity of Kingston, Jamaica, Sept. 11–12, 1906, No. *397*, as bearing a few uredinial sori. He remarks that this may be some other Onagraceous rust, as, for instance, *Uromyces plumbarius* Peck, but that he cannot be certain owing to the scanty material. We have examined the Jamaican specimen both as to rust and host and find it to be identical with ours. We have also examined a specimen on *Jussiaea peruviana* L. collected at Santa Fe, Isle of Pines, Cuba, by J. R. Johnson, No. *2547*, which belongs here. With these three specimens we have no hesitation in establishing a species. The pores are larger, thinner walled and have a different aspect from those of *Uromyces plumbarius* which is known only from the United States.

Uredo Borreriae (P. Henn.) nom. nov.

Uromyces Borreriae P. Henn. Hedwigia **35**: 227. 1896.

On RUBIACEAE:

Borreria verticillata (L.) G. F. W. Meyer. Near Rio Piedras, January 24 to April 5, 1923, *Seaver & Chardon 1309b, 2017b*.

The sori of this uredo-form occur intermixed with those of the short cycle *Puccinia lateritia* Berk. & Curt. P. Henning named *Uromyces Borreriae* from a specimen on *Borreria verticillata* from Rio de Janeiro, Brazil, July 1889, E. Ule, No. *688*. Henning described one-celled teliospores of a *Uromyces* but H. & P. Sydow (Ann. Myc. **6**: 137. 1908) say the scanty original materia contains only a uredo-form. The urediniospores of the Porto Rican specimens agree in size, color, markings and shape with the original description of Henning but the species is here listed as a *Uredo* owing to the great doubt regarding its relation to *Uromyces*. Dr. Arthur has pointed out to us the possibility of referring this form to *Uromyces Spermacoces* (Schw.) Curt. but differences in spore structure, hosts, and geographical distribution have deterred us from accepting the suggestion.

UREDO FARINOSA P. Henn. Hedwigia **36**: 216. 1897.

On LAURACEAE:

Ocotea leucoxylon (Sw.) Mez. Hacienda Maria, Yauco, June 17, 1924, *Whetzel, Kern & Toro 2479.*

This is one of the most conspicuous fungi collected on our trip. It causes striking dusty brown deformations of the inflorescence of this tree host. Almost every inflorescence on the tree was affected. Only a single tree bearing the fungus was found. Our material agrees so well with the original description of *Uredo farinosa* and also with the type material that there can be little if any doubt as to our determination. The type material is from Brazil on a member of the Lauraceae. The fungus is characterized by unusually small spores. It seems very doubtful where such a form as this is to be placed until its life-history is known. It was made the type of a new genus by Patouillard under the name *Clinoconidium farinosum* and referred to the Tuberculariaceae (Bull. Soc. Myc. France **14**: 156. See also Bull. Soc. Myc. France **30**: 445 and E. & P. Nat. Pfl. **1**^{2}: 501).

AECIDIUM

AECIDIUM ABSEDENS Arth. Mycologia **7**: 315. 1915.

On RUBIACEAE:

Randia mitis L. (*Randia aculeata* L.).

Our field observations indicate that this *Aecidium* may be a stage of the grass rust, *Uromyces leptodermus* Syd., on species of *Lasiacis* and *Panicum*. Both the *Aecidium* and the grass rust are very common in Porto Rico. We found them most abundant where the respective host plants were in close association.

UROMYCES

UROMYCES BIDENTICOLA (P. Henn.) Arth. Mycologia **9**: 71. 1917.

Uredo Bidentis P. Henn. Hedwigia **35**: 251. 1896.

Uredo bidenticola P. Henn. Hedwigia **37**: 279. 1898.

Klebahnia Bidentis Arth. Mycologia **7**: 196. 1915.

On CARDUACEAE:

Bidens cynapiifolia H.B.K., *Chardon 1002.*

This appears to be a new host for this rust. A single collection by Chardon, Aug. 26, 1920, from Coamo, Porto Rico, is known to the writers.

UROMYCES CELOSIAE Diet. & Holw.; Holw. Bot. Gaz. **31**: 326. 1901.

Nigredo (?) *Celosiae* Arth. N. Am. Fl. **7**: 246. 1912.

On AMARANTHACEA:

Iresine Celosia L. Lapica, January 24 to April 5, 1923, *Seaver & Chardon 1556.*

This species has been known heretofore only from southern Mexico and Guatemala.

PUCCINIA

PUCCINIA CONSOBRINA Arth. & Holw.; Arth. Mycologia **10**: 129. 1918.

On CYPERACEAE:

Rynchospora corymbosa (L.) Britton. Porto Rico, January 25 to April 5, 1923, *Seaver & Chardon 1798.*

This species originally described from Costa Rica, known also from Jamaica, is represented in Porto Rico by the foregoing collection only.

PUCCINIA SORGHI Schw. Trans. Am. Phil. Soc. II. **4**: 295. 1832.

Dicaeoma Sorghi Kuntze, Rev. Gen. Pl. $\mathbf{3}^3$: 470. 1898.

Aecidium Oxalidis Thüm. Flora **59**: 425. 1876.

On POACEAE:

Zea Mays L. La Carmelita, April 18, 1904, *Clinton 130;* Mayaguez, April 23, 1923, *Tucker 286* (Cornell Univ. Fungi Porto Rico *2685*).

The first report of a rust on corn in Porto Rico was founded on a collection from Naguabo on the slope of El Duque by Mr. J. A. Stevenson in company with Dr. Olive in 1916. Dr. Arthur determined this rust to be *Uredo pallida* Diet. & Holw. *Zea Mays* was a new host for that rust which had previously been known only on *Tripsacum lanceolatum.* The writers collected a rust on corn at the Trujilla Alta Demonstration Farm, June 26, 1924, which is also *Uredo pallida* or, as it is now known, *Puccinia pallescens* Arth. since the discovery of its telial stage (Bull. Torrey Club **46**: 111. 1919). *Puccinia pallida* Tracy, 1893, is a different species. The collections by Clinton, 1904 and by Tucker, 1923, listed above are without doubt the ordinary corn rust, *Puccinia Sorghi*, and this is the first published report of its occurrence in Porto Rico.

MILESIA

MILESIA AUSTRALIS Arth. Bull. Torrey Club **51**: 53. 1924.

Uredo Blechni Diet. & Neger, Bot. Jahrb. **22**: 358. 1896. (Not *Milesia Blechni* Arth. 1922.)

On POLYPODIACEAE:

Blechnum occidentale L. Finca Maria, Yauco, June 19, 1924. *Whetzel, Kern & Toro 2295*, and Rio Prieto, Yauco-Lares Road, June 20, 1924. *2296.*

Polytaenium lanceolatum (L.) Benedict (*Antrophyum lanceolatum* Kef.) N. Y. Bot. Gard., *Sintenis 1800b.*

This is the first report of this species from North America. An earlier collection on *Lygodium polymorphum* by P. C. Standley from Salvador is referred in the Arthur Herbarium to this species. The same fungus is reported from Trinidad on *L. polymorphum.* The Salvador and Trinidad specimens do not agree as well with the type as does the Porto Rican material. The type collection is from Concepcion, Peru, May 1896, on *Blechnum hastatum.* The rust on *Polytaenium lanceolatum* was discovered on a Sintenis specimen, *1800*, in the N. Y. Bot. Gard. herbarium. Dr. Arthur, who examined the material, refers it provisionally to this species.

DESMELLA

DESMELLA SUPERFICIALIS (Speg.) Syd. Ann. Myc. **16**: 242. 1918.
Caeoma superficialis Speg. An. Soc. Ci. Argent. **17**: 96. 1884.
Uredo superficialis De Toni in Sacc. Syll. Fung. **7**: 865. 1888.
Uredo Gymnogrammes P. Henn. Hedwigia **34**: 337. 1895.
Desmella Gymnogrammes Syd. Ann. Myc. **16**: 242. 1918.

On POLYPODIACEAE:

Dennstaedtia rubiginosa (Kaulf.) Moore. Rio Prieto, Yauco-Lares Road, June 20, 1924, *Whetzel, Kern & Toro 2302.*

Dryopteris tetragonia (Sw.) Urban. Finca Limon, Villalba, July 14, 1924, *Whetzel, Kern & Toro 2299;* Rio Prieto, Yauco-Lares Road, June 20, 1924, *2297.*

This rust is common in the higher mountain regions of Porto Rico. It has been referred to previously under the name *Uredo Gymnogrammes* which is now regarded as a synonym according to the foregoing arrangement. The two hosts here listed are new ones for the rust. The uredinia are really subepidermal forming beneath the stomata and protruding in tufts thus appearing superficial. It may possibly be heteroecious.

CEROTELIUM

CEROTELIUM DESMIUM (Berk. & Br.) Arth. N. A. Fl. **7**: 698. 1925.
Aecidium desmium Berk. & Br. Jour. Linn. Soc. **14**: 95. 1875.
Uredo Gossypii Lagerh. Jour. Myc. **7**: 48. 1891.
Kuehneola Gossypii Arth. N. Am. Fl. **7**: 187. 1912.
Cerotelium Gossypii Arth. Bull. Torrey Club **44**: 510. 1917.

On MALVACEAE:

Montezuma speciosissima Sessé & Moc. (*Thespesia grandiflora* DC.). Rio Prieto, Yauco-Lares Road, June 20, 1924. *Whetzel, Kern & Toro 2261;* Ciales Road, July 20, 1924. *2402.*

This is the first report of a rust on this interesting host. The genus *Montezuma* has but two species, the one here listed is endemic in Porto Rico; the other is Cuban. The Porto Rican species is commonly planted as a roadside shade tree. The rust is unquestionably the cotton rust, common on tree cottons and the cultivated sea island cotton throughout Porto Rico.

CEROTELIUM ALIENUM (Syd. & Butler) Arth. N. Am. Fl. **7**: 698. 1925.

Uredo Spondiadis Petch, Ann. Bot. Gard. Peradeniya **5**: 248 1912.

Kuehneola aliena Syd. & Butler; Sydow, Monog. Ured. **3**: 322. 1914.

Cerotelium Spondiadis (Petch) Arth. Bull. Torrey Club **44**: 510. 1917.

On ANACARDIACEAE:

Spondias Mombin L. Near Manati, March 30, 1923, *Seaver & Chardon 2065.*

This is the first collection of this species in North America.

PROSPODIUM

PROSPODIUM TUBERCULATUM (Speg.) Arth. N. Am. Fl. **7**: 161. 1912.

Uredo tuberculata Speg. An. Soc. Ci. Argent. **9**: 172. 1880.

Puccinia tuberculata Speg. An. Soc. Ci. Argent. **10**: 11. 1880.

On VERBENACEAE:

Lantana Camara L. Martin Peña, January 28, 1923, *Seaver & Chardon 1369.*

This is the first collection of this rust in Porto Rico. It is known from central Mexico and has been reported also from Cuba. Only urediniospores have been found on this material but they agree so well with the other collections that there can be no doubt about their identity

RAVENELIA

RAVENELIA PITHECOLOBII Arth. Bot. Gaz. **39**: 394. 1905.

On MIMOSACEAE:

Pithecellobium Unguis-cati (L.) Mart. Vieques, July 17, 1924, *Whetzel, Kern & Toro 2101.*

This single collection from Porto Rico is the only one recorded from this region. Heretofore this rust has been reported from southern Florida, central Mexico and Cuba.

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NOTES AND BRIEF ARTICLES

(Unsigned notes are by the editor)

The New York Botanical Garden was recently favored with a lecture from Professor H. H. Whetzel on the subject "Keeping Plants in the Gardens and Borders Healthy." During his visit Professor Whetzel also spent some time in the Mycological Herbarium.

The recent death of Professor Ellsworth Bethel of Denver, Colorado, has removed another enthusiastic mycologist. For many years Professor Bethel has been a tireless field worker in this line and our own herbarium is dotted through with specimens collected by him. Several years ago we had the privilege of spending considerable time roaming through the Rocky Mountains in search of fungi with him. His death therefore is more or less of a personal loss to us. A more extended note will appear in a later issue.

Mycologists will welcome the appearance of the twenty-third volume of Saccardo's "Sylloge Fungorum," which is being brought to completion by Alex. Trotter and others. This volume contains a photograph of P. A. Saccardo who has done so much in perfecting this extensive and valuable index. It is a satisfaction to know that since his death in 1906 the work is being carried on by his successors. This volume consists of an index to the Basidiomycetes including the rusts and smuts which have been published since the appearance of volume twenty-two in 1913. It contains a record of a large number of American species and will therefore be most useful to American mycologists.

Preliminary Note on the Genus Chrysopsora

The rust genus *Chrysopsora* was founded by Lagerheim[1] in 1891 with one species *C. Gymnoxidis* Lag. as the type and has remained monotypic till 1924 when Arthur [2] added two species *C. Cestri* (P. Henn.) Arth. and *C. Mikaniae* Arth. *Chrysopsora* is characterized by having bright orange sori with long pedicelled teliospores which at first appear to be like *Puccinia.* The spores however have no germ pores and each cell at germination develops three internal cross walls and from each cell thus formed a sterigma is developed on which is borne the sporidium. The germination is similar to *Coleosporium* and *Goplania.* The spore wall is firm and of appreciable thickness.

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[1] Ber. Deutsch. Bot. Ges. 9: 345. 1891.

While studying the Holway rust collections made in South America all three species of *Chrysopsora* have been encountered and a preliminary study reveals that *C. Mikaniae* and *C. Cestri* cannot properly be considered to belong to that genus. In *C. Mikaniae* no *Puccinia*-like stage is evident except in the very young unopened sori. There is a gradual development from a small colorless two-celled stage with no sharp differentiation between spore cell and promycelium. The upper cell gradually elongates and the lower cell simultaneously develops at one side in like manner, giving the structure a shape like a mitten in which the thumb is as large as the hand portion, both being cylindric. When fully mature the contents concentrate in the upper portion of each branch, leaving the lower portion empty and collapsed. Cross walls develop in the upper part as in typical promycelia and sterigmata and sporidia are developed in the usual way. In *C. Cestri* and another undescribed species on *Mikania,* there is an evident *Puccinia*-like stage. The spores have no localized pores and the promycelia develop by the elongation of the cells. The subsequent development is similar to that described above. All species are accompanied by pycnia.

To accommodate these forms the genus **Holwayella** is proposed in honor of Mrs. Mary M. Holway who accompanied Prof. Holway on his South American trips and who has given generously of her time in arranging and caring for the collections. The type species is **Holwayella Mikaniae** (Arth.) n. comb. A more detailed account with descriptions and illustrations is in preparation and will be published in connection with studies of other important South American rusts. H. S. JACKSON

PURDUE UNIVERSITY

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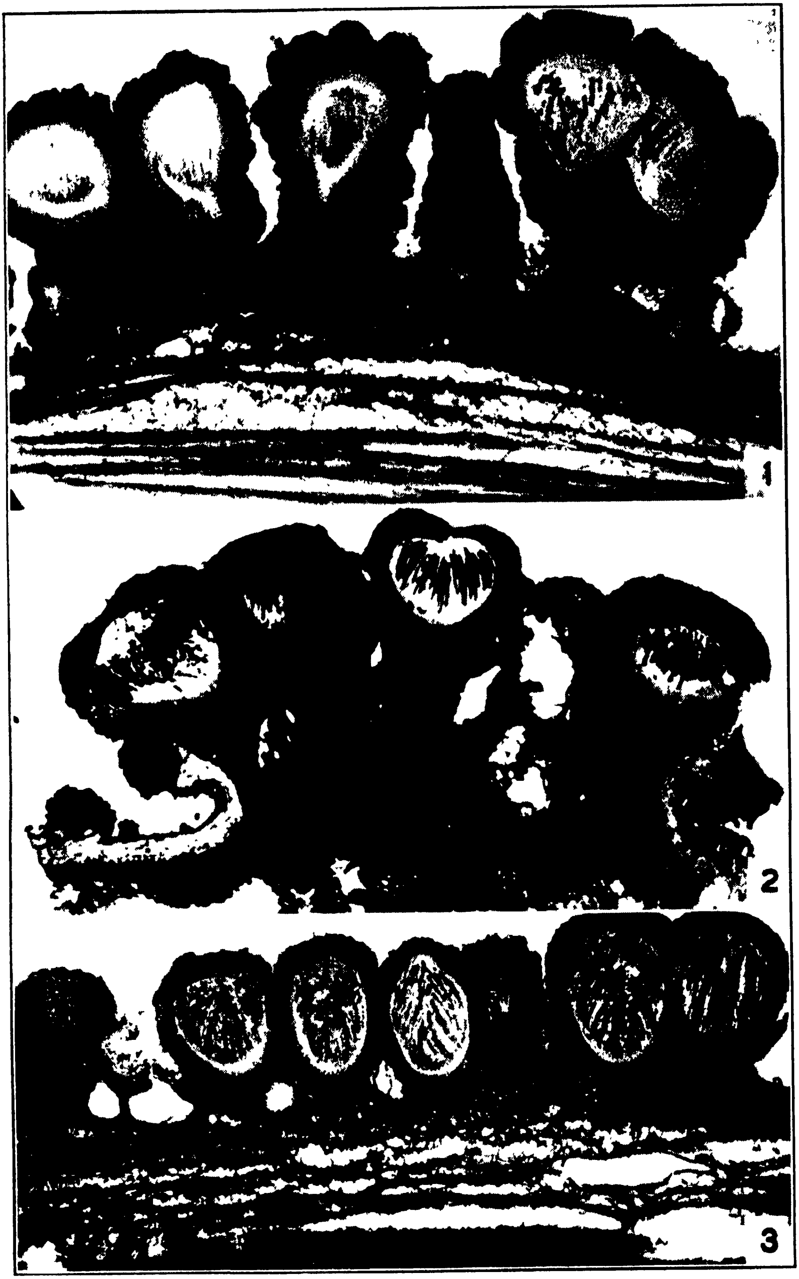
[2] Bull. Torrey Club **51**: 53–54. 1924.



1–3. CUCURBITARIA

MYCOLOGIA

VOL. XVIII MARCH–APRIL, 1926 NO. 2

A MONOGRAPHIC STUDY OF THE GENUS CUCURBITARIA IN NORTH AMERICA[1]

DONALD STUART WELCH

(WITH PLATES 7 AND 8 AND 5 FIGURES IN THE TEXT)

Recent studies by Fitzpatrick (**23**, **24**) have shown that certain forms of the family Cucurbitariaceae Lindau possess characters of unusual and peculiar interest. It is the purpose of the present study to investigate the genus *Cucurbitaria* in the light of these recent additions to our knowledge of the group.

The genus name *Cucurbitaria* was first used in 1821 by S. F. Gray (**29**). He described four species, three of which were subsequently removed to other genera. The remaining species, *C. Berberidis*, is considered the type of the genus. It was based on *Sphaeria Berberidis* Persoon, a well defined species, of wide distribution, commonly collected, and occurring, as far as known, only on species of *Berberis* L. The type specimen in the herbarium of Persoon is plentiful, well preserved, and has fortunately been available for study and comparison. The species commonly collected in North America on *Berberis* has been found to be identical with this.

The basis of the genus being thus well established, a study of the remaining species has been undertaken in order to determine the characters and limits of the group. The present work is

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[1] Also presented to the Faculty of the Graduate School of Cornell University as a major thesis in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

[MYCOLOGIA for Jan.–Feb. (**18**: 1–49) was issued Jan. 1, 1925]

confined to a consideration of the species which have been reported from North America, but since many European species occur in the list it is believed that the study will be representative of the genus as a whole. The total list for North America includes 77 names. These have been collected from all available sources, the list constituting a fairly complete compilation of the species of this continent. Many of the names are merely synonyms, and long recognized as such, but for the sake of completeness all are included.

The position of the genus in the scheme of classification has been well established in literature. Saccardo (**56**), using the muriform character of the spore as the basis for primary separation, placed the genus in the Sphaeriaceae-phaeodictyae, distinguishing it from the other genera of the group by the characterization "*perithecia cespitose.*" The family Cucurbitariaceae was first described by Lindau (**41**) essentially as follows: fruit-bodies cespitose, formed beneath the epidermis, later erumpent and remaining exposed, seated on a firm felt-like crust or pulvinate stroma; walls leathery or carbonaceous, compact. The family has been generally accepted and remained unquestioned until 1918 when Theissen and Sydow (**63**), following a study of the type specimen, proposed placing the genus in the Pseudosphaeriales. This order is an extension of the family Pseudosphaeriaceae of von Höhnel (**32**) founded in 1907 to include forms having a perithecium-like stroma containing groups of asci in which each ascus is enclosed in a separate chamber or loculus. Von Höhnel's characterization reads as follows: "*Stromata klein, eingewachsen, peritheciumähnlich, mit mehreren nebeneinander stehenden Loculi die je einer Ascus enthalten.*" Theissen and Sydow (**63**) in proposing the order Pseudosphaeriales made the following statement showing the importance which they attached to the characters attributed to the earlier group: "*Als vorläufig einziges Merkmal müssen wir die streng perithizienartig Fruchtkörper mit monasken Lokuli (d.h. durch gewebsfassen getrennten Asken) festhalten.*"

The proposed changes in the formation of this new order involve genera of the Pleosporaceae as well as the Cucurbitariaceae. The radical character of these changes invites a careful scrutiny of the reasons advanced. The writer has not been able to discover any evidence of the presence of loculi enclosing single asci in the Persoon type or in any other specimen examined. Lacking a confirmation of the findings of Theissen and Sydow it is concluded that the placing of the family Cucurbitariaceae in the Pseudosphaeriales is unwarranted

During the studies included in this work it has been found necessary to make general use of hand sections of all material examined. Without these a correct interpretation of the structure of these fungi is impossible, a fact the importance of which can not be overestimated. The distinctive characters of the Sphaeriales are such as may be seen only by the use of thin sections of perithecia and stromata. Such, for example, is the only positive means of demonstrating the clypeus.

This investigation would not have been possible without the kind coöperation of mycologists and botanists both in Europe and America who aided in the obtaining of specimens for examination. Thanks are especially due to Doctor F. J. Seaver for permission to freely consult the valuable specimens in the Ellis Herbarium and other collections at the New York Botanical Garden, to Professor Roland Thaxter for likewise extending the courtesies of the Farlow Herbarium and Library of Cryptogamic Botany at Harvard University, and to Doctor Francis Pennell for permission to examine material from the Schweinitz Herbarium at the Philadelphia Academy of Sciences. The writer is also indebted to Doctor W. H. Weston for assistance in the use of the Bibliographical Index of North American Fungi maintained at the Farlow Library and to Mr. A. P. D. Piguet for valuable service in connection with the checking of the bibliography. To individuals who have generously responded to requests for material the writer owes also a debt of gratitude.

Many of the specimens examined in the course of these investigations have been returned to the original sources but some of the materials, including the writer's own collections, and all of the slides except those of material from Harvard University are deposited in the Plant Pathology Herbarium of the New York State College of Agriculture at Cornell University.

This work has been carried on under the direction of Doctor

H. M. Fitzpatrick for whose encouragement and helpful suggestions the writer wishes here to express his appreciation.

The photographs were made by Mr. W. R. Fisher and the text figures are the work of the writer.

CUCURBITARIA Gray, Nat. Arr. Brit. Pl. **1**: 519. 1821

Perithecia dark brown or black, carbonaceous, turbinate, with thick walls and a thickened elongated basal extremity, erumpent, cespitose, seated on a pseudoparenchymatous stroma or a subiculum of dark brown hyphae, frequently collapsing apically at maturity but not deeply; ostiolum surrounded by a papilliform prominence, sometimes obscure, becoming perforate with age; asci cylindrical, short stipitate, thick-walled, 2-, 4-, 6-, 8-spored (mostly 8), persistent; paraphyses filiform, abundant; ascospores mostly uniseriate, ellipsoidal with 3 to 9 or more cross walls and muriform by several longitudinal septations, constricted at the middle septum, straw-yellow changing to deep olive-brown or red-brown with age. Saprophytic, at least in the perithecial stage, and growing on wood.

Varying conceptions of the limits of the genus have existed from time to time. The original description given by Gray (**29**), although brief, is yet quite suggestive of the true nature of members of the genus. "*Thallus spreading, irregular; thecae in tufts placed on the thallus.*" Greville (**30**) offers the following characterization of the genus, based on *C. Berberidis* (Pers.) Gray: "*Spherules carneous, tufted, free, fixed on a receptacle, sometimes at first included. Interior filled with a gelatinous sporuliferous mass.*"

Tulasne (**65**), who was the first to attempt a lengthy description, calls attention to the irregular occurrence of the colored mycelium merging with the fleshy fruit-bodies, the latter variously arranged in circles, ridges or tufts, emerging from the mycelium or stroma or seated on the bare substratum. The "*conceptacula*" or perithecia are described as being "*often smooth, free or confluent, raised, rugulose-tuberculate, commonly obtuse, beakless and minutely papillate or more often umbilicate, finally perforate.*" Pycnospores are described as varying considerably in shape, size, color and septation while the ascospores are said to be biloculate or "*multipartitae,*" lightly or deeply colored, smooth, muticate, monostichous in elongate, 8-spored asci with thick walls; the paraphyses crowded. Karsten (35) adds little to the above except that he uses "*murali-divisae*" to describe the septation of the spores, this being the first reference to the muriform character of the ascospores now recognized as one of the important features of the genus. Saccardo (56) makes use of Karsten's description almost verbatim in his account of the genus in the Sylloge Fungorum. He further notes that some species having gregarious perithecia, not truly cespitose, approach *Teichospora*. Winter (68) calls attention to the stalk-like basal portion in some species and to the variable number of spores in the ascus (6–8). Ellis and Everhart (16) and Berlese (2) add nothing of significance to the previous accounts.

Due to the indefinite character of the early descriptions there developed several widely differing conceptions of this genus among the early American mycologists. Thus we find some, like Doctor Peck, placing in the genus any form having black cespitose perithecia, regardless of the character of the spores, while others, notably Ellis, are found regarding the muriform spore and cespitose habit together as constituting typical characters of the genus. The result has been that a large number of different forms have fallen at one time or another under the name *Cucurbitaria* and a critical examination of the species said to belong to this genus shows clearly that the group includes representatives from a number of different genera.

Preliminary to this study a general survey of the muriform-spored genera of the Sphaeriales was made from which it became evident that a great deal of confusion exists among these forms. For example, the genera to which *Cucurbitaria* appears to be most closely related according to the natural classification are *Teichospora* Fuckel (= *Strickeria* Körber) in the Amphisphaeriaceae and *Crotonocarpia* Fuckel in the Sphaeriaceae. Specimens of the type species of both of these genera have been examined and it is evident that the present conceptions of these forms do not conform with the types (PL. 8, FIGS. 7 and 8). It is beyond the scope of the present work to consider these genera further. Therefore in the treatment of excluded species the definite transfer of many of these in advance of monographic work on related genera has been purposely avoided.

In the meantime it becomes necessary to designate in some way the general character of the species which in the revision here set forth must be excluded from the genus. It is believed that this can be done best by arranging such species according to the families which they appear to represent, leaving the subject of their final treatment to further investigation.

No account of the genus would be complete without mention of the treatment accorded the group by O. Kuntze (**39**) in his stupendous work on the revision of the genera of the plant kingdom. Here the genus has been renamed according to that author's interpretation of the rules of botanical nomenclature. The alterations in so far as they apply to *Cucurbitaria* Gray consist in the assigning of the new genus name *Gibberidea* O. Kuntze to the group and changing *Nectria* Fries to *Cucurbitaria.* For this procedure Kuntze offers the following explanation. The genus as originally described by Gray (**29**) contained 4 species, viz.: *C. Berberidis* based on *Sphaeria Berberidis* Persoon, *C. cupularis* on *Sphaeria cupularis* Persoon, *C. rubra* on *Sphaeria cucurbitula* f. *flavescens* Tode, and *C. coccinea* on *Sphaeria coccinea* Persoon [= *Sph. decidua* Tode]. Subsequently the last two species were transferred by Fries (**27**) to *Nectria*, *C. cupularis* was made *Nitschkia cupularis* by Karsten (**35**) and there remained only one species, *C. Berberidis.* According to the rules as understood by Kuntze, *Cucurbitaria* Gray *ex parte majore* is *Nectria* Fries, following Art. 54, Sect. 5 of the Rules of Botanical Nomenclature (**10**) adopted at the International Botanical Congress held at Paris in 1867.

With the purpose, in view of testing the reasonableness of applying this rule in such a way, let the facts be reviewed in chronological order. Fries separated the species *rubra* and *coccinea* from the group in 1849, leaving as many species as were removed. Later when Karsten (**35**) called *C. cupularis* a *Nitschkia* the same process of dividing in two was repeated, except that in this case there was a recognizable difference in the size of the two groups. Several species of *Cucurbitaria* had in the meantime been described, Fuckel alone having given 18 species in 1869, while *Nitschkia* was a small group, containing at that time, according to Karsten (**35**), only two species. It may thus be seen that there had been no violation of the rules prior to Kuntze even though they were *ex post facto* in the case of the first change. It is therefore concluded that the name *Cucurbitaria* Gray is acceptable according to present usage and that the genus is therefore valid.

For convenience the discussions of the doubtful and excluded species are arranged in alphabetical order under the following headings: I. Doubtful species, II. Excluded species (*A*. Species related to the Amphisphaeriaceae, *B*. Species related to the Sphaeriaceae, *C*. Other excluded species and synonyms).

KEY TO THE NORTH AMERICAN SPECIES OF CUCURBITARIA

Spores 7–9 or more septate, perithecia rough .... 1. *C. Berberidis*
Spores 5–7-septate.
  Underlying stroma pulvinate.
    Perithecia brown .... 2. *C. Caraganae*
    Perithecia black....... .... 3. *C. Laburni*
  Underlying stroma scanty or effused .... 4. *C. elongata*
Spores 3-septate, rarely 4–5-septate...................... 5. *C. arizonica*

1. CUCURBITARIA BERBERIDIS (Pers.) Gray, Nat. Arr. Brit. Pl. 1: 519. 1821

Sphaeria Berberidis Persoon, Syn. Fung. 52. 1801.

Gibberidea Berberidis (Rabenh.) O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Perithecia cespitose, in groups varying from few to very many, appearing in elongated crevices of the ruptured outer bark, rough, irregular, black, turbinate to subglobose, often confluent at the base, not collapsing, 600–760 μ in diameter, walls often 70–90 μ in thickness with the outer cells opaque and black and the inner cells olive-green; ostiolum perforate; subiculum of dark hyphae which connect the pointed or stipitate bases of the turbinate perithecia, subiculum sometimes scanty, in which case there is a pseudoparenchymatous stroma connected directly with the cortical tissue; asci 150–180 × 11–15 μ, 4-, 6-, 8-spored; spores slightly pointed, 7–9 or more septate with many longitudinal divisions which impart to the mature spore a finely muriform appearance, olive-brown, 27–31 × 10–12 μ, occasionally larger in 4- or 6-spored asci. (PL. 7, FIG. 1; PL. 8, FIGS. 5, 9.)

Type collected on *Berberis vulgaris* and all the known specimens found on species of this genus.

This species is the type of the genus and is easily recognized by its rugulose perithecia and its constant occurrence on *Berberis*.

MATERIAL EXAMINED

Persoon, Type material, Nos. *910–270–291*, *910–270–261*, *910–270–301*.
Herb. D. S. Welch *35*, *36*, *37*, *352*, *358*, *361*.
Petrak, Flora Moravica (in Herb.).
Ellis, N. Am. Fungi *578* (at Cornell Univ. and N. Y. Bot. Gard.).
Ellis & Everhart, Fung. Columb. *1915* (at Cornell Univ. and N. Y. Bot. Gard.).
Atkinson Herb. 2 specimens, Berkeley coll. (at Cornell Univ.).
Krieger, Fungi Saxonici *1261* (at Cornell Univ. and N. Y. Bot. Gard.).
Roumeguère, Fung. Gall. *563* (at Cornell Univ. and N. Y. Bot. Gard.).
Rabenhorst, Fung. Europ. *2230* (at Cornell Univ. and N. Y. Bot. Gard.).
Rehm, Ascom. *281* (at N. Y. Bot. Gard.).
Sydow, Myc. March. *2943* (at N. Y. Bot. Gard.).
Plants of Southern Colorado (at N. Y. Bot. Gard.).

2. CUCURBITARIA CARAGANAE Karst. Medd. Soc. Fenn. **2**: 182. 1878

Gibberidea Caraganae O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Perithecia erumpent, densely cespitose in groups 2–10 × 1–4 mm. wide, appearing elevated above the ruptured bark, smooth, dull, dark brown, turbinate, 425–550 μ in diameter, collapsing so as to appear flattened at the top, walls (in section) 50–80 μ in thickness and of a uniform dark red-brown color; ostiola papilliform, becoming perforate with age; stroma pulvinate, consisting of masses of dark hyphae in which the elongate basal portions of the perithecia are imbedded; asci 4-, 6-, 8-spored, 125–175 × 11–12 μ; spores ellipsoidal, 5–7-septate (mostly 7), pointed at both ends and slightly curved, dark olive-brown, 25–29 × 8–10 μ. (PL. 8, FIG. 4.)

Type collected on *Caragana arborescens* in Finland (Mustiala). Found also on *Elaeagnus* sp.

This species differs from *C. Laburni* chiefly in having lighter colored perithecia with smooth walls. Karsten (**36**), in his original description of the species, states that in addition to the above mentioned differences there is also one of size of groups of perithecia but this has been found not to hold. The color differences in the perithecial walls are very striking when thin sections of the two are compared. *C. Caraganae* has a uniform color throughout, a rich dark brown, while *C. Laburni* has a wall composed of olive-brown cells with an outer layer of black carbonaceous structure. The fungus collected by Brenckle (**3**) on *Elaeagnus argentea* and cited by him as *C. Caraganae* Karst. var. *Elaeagni* Rehm appears not to differ from *C. elongata* (Fries) Grev. to which species it has been referred. Von Höhnel (**33**) states that *Pseudodichomera Elaeagni* (Karst.) v. H. (= *Dichomera Elaeagni* Karst.) is an imperfect stage of *Cucurbitaria Caraganae* Karst.

MATERIAL EXAMINED

Karsten Herb. 4 specimens, one of which is the type.
Saccardo, Myc. Ital. *490* (at N. Y. Bot. Gard.).
de Thümen, Myc. Univ. *1066* (at N. Y. Bot. Gard.).
ex de Thümen Herb. no number, coll. by Karsten (at N. Y. Bot. Gard.).
Rabenhorst, Fungi Europ. *3857* (at N. Y. Bot. Gard.).

3. CUCURBITARIA LABURNI (Pers.) de-Not. Erbar. Critt. Ital. No. *875*. 1862

Sphaeria Laburni Pers. Syn. Fung. 50. 1801.
Gibberidea Laburni O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Perithecia erumpent, densely cespitose, in irregular patches which range from 1 mm. to 1 cm. or more in diameter and often coalesce, raised above the ruptured epidermis, minutely roughened, black, turbinate, the basal portions often fusing, collapsing but slightly so as to appear somewhat flattened, 650–900 μ in diameter, walls (in section) 50–80 μ thick, cells dark olive-brown and the outer walls of the outermost cells black; ostiolum distinctly papilliform, persistent; stroma pulvinate, forming a pseudoparenchymatous cushion which merges below into a closely woven mass of dark hyphae interwoven with the tissues of the cortex; asci 180–195 × 12–17.5 μ, 8-spored; spores oblong ellipsoidal, dark olive-brown, 5–7-septate (mostly 7), 25–31 × 9–10 μ. (PL. 7, FIG. 2.)

Type collected on *Cytisus Laburni*.

This species is most closely related to *C. Caraganae* Karst. The points of difference are enumerated in the discussion of the latter. The elongate bases of the perithecia in both species are seen only in sections cut at or near the center of the perithecium.

In the course of these studies no imperfect fungus has been found associated with this species but numerous references to such forms are found in the literature. Tulasne (**65**) describes a pycnidial stage with ovate or cylindrical, non-septate, hyaline "*stylospores*," 5–10 × 3.5–5 μ, and also another pycnidial form with spores dark, 3–4-septate, muriform, 20–30 × 7–10 μ. Fuckel (**28**) mentions also a "*fungus pycnidium*" which he calls *Diplodia Cytisi* Aud. Saccardo (**56**) suggests that *Camarosporium Laburni* Sacc. & Roum. is a pycnidial stage of *Cucurbitaria Laburni*. Von Höhnel (**33**) gives *Pseudodichomera Laburni* (Cooke & Mass.) v. H. (= *Dichomera Laburni* Cooke & Mass.) as an imperfect stage of *C. Laburni*. According to this author other forms of the same species are *Camarosporium Laburni* (West.) Sacc., *C. laburnicum* Sacc., and *C. Cytisi* Berl. & Bres.

MATERIAL EXAMINED

Persoon Herb. 3 specimens from the Rijks Herbarium, Leiden, Netherlands. Nos. *1-924-1*, *-2*, and *-3*.

Herb. D. S. Welch No. *576*.

Atkinson Herb. specimen collected in Europe by P. Magnus (at Cornell Univ.).

Roumeguère, Fung. Gall. *492*, *985* (at Cornell Univ.).

Petrak, Flora Moravica, from herbarium of H. M. Fitzpatrick (at Cornell Univ.).

Cesati & de-Notaris, Erbar. Critt. Ital. *875* (at Harvard Univ.).

Fuckel, Fung. Rehn. *965* (at Harvard Univ.).

Saccardo, Myc. Ital. *1494* (at N. Y. Bot. Gard.).

4. CUCURBITARIA ELONGATA (Fries) Grev. Scottish Crypt. Fl. 4: tab. 195. 1826

Sphaeria elongata Fries, Syst. Myc. **2**: 422. 1823.

Sphaeria Amorphae Wallr. Fl. Crypt. Ger. **4**: 781. 1833.

Sphaeria Coluteae Rabenh. Herb. Myc. *1239*. 1849.

Cucurbitaria Coluteae Auersw. *in litt.* Fuckel, Symb. Myc. *174*. 1869.

Cucurbitaria Amorphae Fuckel, l.c.

Cucurbitaria Ailanthi Rabenh. Fungi Europ. *1833*. 1874.

Cucurbitaria Negundinis Wint. *in* Rabenhorst, Kryptogamen-Flora 1^2: 329. 1887.

Gibberidea Amorphae O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.

Gibberidea Coluteae O. Kuntze l.c.

Gibberidea elongata O. Kuntze l.c.

Gibberidea Ailanthi O. Kuntze l.c.

Cucurbitaria Spartii (Nees.) Ces. & de-Not. forma *Sophorae* Feltg. in von Höhnel, Sitz-ber. Akad. Wiss. Wien **115**: 1217. 1906.

Cucurbitaria Caraganae Karst. var. *Elaeagni* Rehm; Brenckle, Mycologia **9**: 279. 1917.

Perithecia erumpent in elongate clusters through irregular openings in the outer bark, sometimes appearing single, surface minutely roughened, dull, black, carbonaceous, subspherical to turbinate, crowded, rarely confluent, collapsing to flat-topped, sometimes umbilicate but never deeply cupulate, 290–680 μ in diameter (mostly 340–500 μ), walls mostly 40–60 μ in thickness when seen in cross section, brown; ostiolum papilliform, appearing greyish at maturity and later collapsing; perithecia seated upon a subiculum which is composed of a mass of dark interwoven hyphae, broadly spreading and involving the cortical tissue often over large areas, these hyphae are septate and of a purple-brown color with a metallic luster; asci 120–195 × 11–15 μ (mostly 130–160 × 11–13 μ), 2-, 4-, 6-, 8-spored; spores irregularly uniseriate, somewhat variable in shape and size due to the varying number found in the ascus, oblong ellipsoidal, 5–7-septate, hyaline changing to dark brown, 21–33 × 8–13.6 μ (mostly 23–27 × 9–11 μ). (PL. 7, FIG. 3.)

Type collected on *Robinia pseudacacia*, also found on *Amorpha fruticosa*, *Elaeagnus argentea*, *Elaeagnus angustifolia*, *Colutea arborescens*, *Acer Negundo*.

This is without doubt the best known of the species of *Cucurbitaria*. Striking characteristics of the species are: the flat tops of the perithecia when seen in section, the variability of the spores in shape and size and the varying number of spores in the ascus. Greville (**30**) reports as many as ten but the writer has never seen more than eight. A number of species have been merged here because of their agreement in detail with the type of *C. elongata*. Type specimens have been consulted in nearly all cases and a large number of specimens has been examined.

An imperfect fungus, *Camarosporium Robiniae* (West.) Sacc., is often found associated with this species, the pycnidia much like the perithecia in size, shape and structure and occupying the same relative position with respect to the stroma or subiculum. Although positive proof based on cultural or inoculation experiments is lacking it is strongly indicated that the *Camarosporium* is the imperfect stage of the *Cucurbitaria.* The pycnospores are 17–21 × 7–8 μ, mostly 3–5-septate, dark brown, muriform, ovate or oblong elliptical, somewhat irregular in shape, with no tendency to become constricted at the septa.

Tulasne (**65**) describes two types of spores in addition to ascospores. The "*microstylospores*" pale, linear-ovate, non-septate, 6.4 × 2.0 μ, the "*macrostylospores*" ovate or oblong-ovate, obtuse at the ends, 13–16 × 5–8 μ, 3–5-septate and dark brown in color. The latter fungus is evidently the same as the *Camarosporium* examined by the writer and described above although there is some difference in the length of the spores. According to Fuckel (**28**) these "*macrostylospores*" occur in the same "*perithecia*" as the asci and forms are found having 5 or even 8 septa. Von Höhnel (**33**) makes the statement that *Camarosporium Robiniae* (West.) Sacc., *C. fenestratum* (Berk. & Curt.) Sacc. and *C. Pseudoacaciae* Brun. are identical. He further determined that *Haplosporella chlorostroma* Speg. is but an immature form of this *Camarosporium.*

MATERIAL EXAMINED

Fries, Sclerom. Suec. *33.* Type, received from Fries Herbarium and also examined at Harvard Univ.

Rabenhorst, Fung. Europ. *340*, *822*, *2550* (at N. Y. Bot. Gard.).

Ellis & Everhart, N. Am. Fungi *1955* (at N. Y. Bot. Gard. and Cornell Univ.).

Ellis & Everhart, Fung. Columb. *716* (at N. Y. Bot. Gard. and Cornell Univ.).

Krieger, Fungi Sax. *769* (at N. Y. Bot. Gard. and Cornell Univ.).

Roumeguère, Fung. Gall. *564*, *2753* (at N. Y. Bot. Gard. and Cornell Univ.).

Rehm, Ascom. *336* (at N. Y. Bot. Gard.).

Ravenel, Fung. Car. 3: *56* (at N. Y. Bot. Gard.).

Beck & Zahlbr. Krypt. Exsic. Mus. Palat. Vindob. *617* (at N. Y. Bot. Gard.).

Saccardo, Myc. Ital. *1043* (at N. Y. Bot. Gard.).
Herb. C. A. King, coll. Cambridge, Massachusetts (at N. Y. Bot. Gard.).
Herb. Ellis, coll. Fairman, Lyndonville, N. Y. (at N. Y. Bot. Gard.).
Mougeot & Nestler *875* (at N. Y. Bot. Gard.).
Sydow, Myc. March. *146*, *3834* (at N. Y. Bot. Gard.).
Herb. Plant Path. Cornell Univ. *9731*, also *6989* from Meschitt coll. det. by Ellis.
Herb. D. S. Welch *40*, coll. Ithaca, N. Y.
Atkinson Herb. 2 specimens (at Cornell Univ.).
Flora Moravica (from Doctor Petrak.).

As C. COLUTEAE:

Rabenhorst, Herb. Myc. *1239*, type (at Harvard Univ.), another specimen sent by Doctor Sydow.
Rabenhorst, Fung. Europ. *2578* (at N. Y. Bot. Gard. and Cornell Univ.).
Rehm, Ascom. *637* (at N. Y. Bot. Gard.).
Roumeguère, Fung. Gall. *7317*, 2 specimens (at N. Y. Bot. Gard.).
Bartholomew, Fung. Columb. *4115* (at N. Y. Bot. Gard. and Cornell Univ.).
Krieger, Fung. Sax. *1262* (at N. Y. Bot. Gard. and Cornell Univ.).
Atkinson Herb. *19755* (at Cornell Univ.).
Herb. D. S. Welch *312*, coll. Ithaca, N. Y.

As C. AMORPHAE:

Rabenhorst, Herb. Myc. *732* (at Harvard Univ.).
Rabenhorst, Fung. Europ. *1627* (at N. Y. Bot. Gard.).
Fuckel, Fung. Rehn. *971* (at Harvard Univ.).

As C. AILANTHI (*C. Negundinis*):

Rabenhorst, Fung. Europ. *1833*, 2 specimens and *2250* (at N. Y. Bot. Gard.).

As C. CARAGANAE VAR. ELAEAGNI:

Brenckle, N. Dak. Fung. *758* (from Rehm Herb.), Fung. Dak. *306* and *477*, 3 specimens of each.
Herb. D. S. Welch *552*, coll. Brenckle.

5. CUCURBITARIA ARIZONICA Ellis & Ev. Jour. Myc. **8**: 16. 1902

Perithecia erumpent, densely gregarious, often crowded, rarely occurring singly, at maturity appearing above the ruptured bark or on the cortical tissue from which the outer layers have disappeared, dull brownish black, carbonaceous, minutely verrucose but not distinctly roughened, subspherical to turbinate, 350–500 μ in diameter, terminated by a short papilliform projection around the ostiolum, sometimes collapsing but not deeply, often becoming perforate with age, seated upon a pseudoparenchymatous stroma which frequently gives place below to a mass of densely woven hyphae of a rich brown color which mingle with the partly disorganized tissues of the cortex; asci 8-spored, 130–150 × 10–12 μ; spores obliquely and irregularly uniseriate, frequently overlapping, mostly 3-septate (rarely 4–5-septate) and muriform by one or at most two or three longitudinal divisions, straw-yellow at first becoming dark brown with a faint tinge of olive, 21–25 × 7–8 μ. (PL. 8, FIG. 6.)

This differs from *C. Astragali* Ellis & Ev. only in the possession of the turbinate character of the perithecia. Ellis gives the dimensions of the spores in his specimen as 14 × 6–8 μ.

MATERIAL EXAMINED

Griffith, West Am. Fungi *313* (at Cornell Univ.).
Ellis Herb. *type* (at N. Y. Bot. Gard.).
Brenckle, N. Dak. Fungi *775* (in Brenckle Herb.).

I. DOUBTFUL SPECIES

1. CUCURBITARIA ACERVATA (Fries) Ces. & de-Not. Comm. Soc. Critt. Ital. **1**: 214. 1863

Sphaeria acervata Fries, Syst. Myc. **2**: 416. 1823.
Gibberidea acervata O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Two collections of this fungus have been reported from North America. Cooke (**5**) refers to a specimen (Berk. exs. No. *174*) collected on apple in South Carolina. There is a portion of this in the von Höhnel collection at Harvard University (*A 3310* Berk. Brit. Fung. *174*) which upon examination proved to have hyaline spores. Schweinitz (**58**) reported a collection on *Populus* from Bethlehem, Pennsylvania. The spores of this were found to be hyaline and 1-celled and no asci were seen.

From the original description of this fungus as given by Fries it might be a good *Cucurbitaria*. Tulasne (65) has examined the de-Notaris specimen and states that it is not the same as that of Fries but resembles *C. elongata*. It has not been possible to obtain type specimens of this species and no definite conclusions can be drawn from the information at hand.

2. CUCURBITARIA CONGLOBATA (Fries) Ces. & de-Not. Comm. Soc. Critt. Ital. **1**: 214. 1863. (Not *C. conglobata* (Fries) Karst. for which see *C. Karstenii* Sacc.)

Sphaeria conglobata Fries, Syst. Myc. **2**: 414. 1823.
Gibberidea conglobata O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Type material from the Fries Herbarium was found to be too immature for study and unsatisfactory for comparison. All the American collections referred to this species have been found to fall readily elsewhere and it is doubtful if the species is represented in America unless, as seems possible, it is synonymous with *C. Coryli*.

3. CUCURBITARIA CORYLI Fuckel, Symb. Myc. 308. 1871

Gibberidea Coryli O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Material from the herbarium of Fuckel was obtained for study but no asci or spores could be found. The perithecia were found to have thick walls and to be seated upon a definite stromatic subiculum. A specimen collected by the writer on *Corylus americana* yielded muriform spores but the perithecia in section were thin-walled and resembled *Pleospora*, as did also another collection made by Burt from *Corylus rostrata*.

The scanty evidence furnished by the above specimens and the descriptions of this species by Fuckel and others indicate a similarity to *Cucurbitaria Fraxini* Ellis & Ev. and it is suspected that further investigation will reveal that the forms found on *Fraxinus*, *Corylus*, *Betula*, *Salix*, and other similar hosts and called variously *Cucurbitaria Fraxini*, *C. Coryli*, *C. conglobata*, etc., all belong to the same species.

4. CUCURBITARIA FRAXINI Ellis & Ev. Proc. Acad. Phila. 240. 1890

Cucurbitaria Salicis Ellis & Ev. in herb.
Gibberidea Fraxini O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The specimen found in the Ellis collection at the New York Botanical Garden has deteriorated and furnishes little evidence of what the fungus might have been like. A specimen in Griffith's West American Fungi *198*, collected on *Fraxinus americana* at Aberdeen, South Dakota, has perithecia immersed at the base in the host tissue and is clearly not a *Cucurbitaria*.

5. CUCURBITARIA GLEDITSCHIAE (Schw.) Ces. & de-Not. Comm. Soc. Critt. Ital. **1**: 214. 1863

Sphaeria Gleditschiae Schw. Schr. Nat. Ges. Leipzig **1**: 40. 1822.
Melogramma Gleditschiae Berk. Grevillea **4**: 98. 1875.
Cucurbitaria Gleditschiae Berk. Grevillea **4**: 47. 1875.
Botryosphaeria Gleditschiae Sacc. Syll. **1**: 463. 1882.
(?) *Otthia Gleditschiae* Sacc. Syll. **2**: 310. 1883.
Valsaria Gleditschiae Cooke, Grevillea **13**: 109. 1884–5.
Gibberidea Gleditschiae O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.
Trematosphaeria Triacanthi Feltg. in herb.
Cucurbitaria recuperata Theissen, Ann. Myc. **14**: 333. 1916.

Theissen (**61**) has treated this species very fully. He studied three specimens at Kew, one from Schweinitz which he assumed to be the original, and two specimens, No. *922* and Fung. Car. *942* from Berkeley's Herbarium. According to Theissen these are all identical. He states that these differ from the fungus called *Cucurbitaria Gleditschiae* by Cesati and de-Notaris (**4**) by the presence of smooth perithecia while the "*Italian*" fungus is rough "*according to the description*." It is difficult to say what description is meant here. Cesati and de-Notaris published no description with their fungus and Schweinitz does not mention the rough character for *Sphaeria Gleditschiae*.

Theissen further states that the fungus which he studied may be distinguished from *C. elongata* (Fries) Greville only by the presence in the latter of a broadly effused stroma. From the description which Theissen has given it seems probable that his fungus is a form of *C. elongata* with scanty stroma, since it has been shown that the broadly effused character of the stroma is not distinctive for this species.

The writer has examined type material of *Sphaeria Gleditschiae* from the Schweinitz Herbarium. This specimen has 2-celled olive-brown spores and no asci are evident.

6. CUCURBITARIA HYPERICI (Schw.) Cooke, Grevillea **15**: 86. 1886

Sphaeria Hyperici Schw. Trans. Am. Phil. Soc. II. **4**: 205. 1832.

This is one of the 8 forms listed by Cooke (l.c.) as "*species incertae.*" Material has not been examined.

7. CUCURBITARIA JUNIPERICOLA (Schw.) Cooke, Grevillea **15**: 86. 1886

Sphaeria junipericola Schw. Trans. Am. Phil. Soc. II. **4**: 205. 1832.

(?) *Sphaeropsis junipericola* Cooke, Grevillea **15**: 80. 1886.

This is one of 8 forms listed by Cooke (l.c.) as "*species incertae.*" Material has not been examined.

8. CUCURBITARIA KARSTENII Sacc. Syll. Fung. **2**: 313. 1883

Sphaeria conglobata Fries, Syst. Myc. **2**: 414. 1823.

Cucurbitaria conglobata Karst. Medd. Soc. Faun. Fl. Fenn. **5**: 33. 1879.

Gibberidea Karstenii O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

No American collections of this fungus have been available for study. The Karsten Herbarium has yielded some excellent material but the Saccardo specimen is practically worthless and no conclusion can be drawn as to what Saccardo had in mind when he published this species. He states that the Karsten fungus differs from *Sphaeria conglobata* Fries *in its rugulose perithecia and broader sporidia* but he fails to give the dimensions of the Friesian specimen and we have no adequate description of the *Sphaeria conglobata* of Fries.

9. CUCURBITARIA KELSEYI Ellis & Ev. Proc. Acad. Phila. **42**: 240. 1890

Gibberidea Kelseyi O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Fenestella minor Tul. *in* Berlese, Icones Fung. **2**: 77. 1900.

An examination of the type material collected by Kelsey, found in the Ellis collection at the New York Botanical Garden, indicates that the fungus is somewhat like a *Cucurbitaria* but sufficient evidence to definitely place it is at present lacking. Berlese was apparently not justified in placing this species in the genus *Fenestella.*

10. CUCURBITARIA LIGUSTRI H. Fabre, Ann. Sci. Nat. VI. **9**: 116. 1878

Gibberidea Ligustri O. Kuntze, Rev. Gen. Pl. 3²: 481. 1898.

The only material of this species which has been available is an American specimen from the collection of James R. Weir in the herbarium at the New York Botanical Garden. In this specimen there are no asci but pycnidia are found in which small hyaline one-celled spores are produced in abundance. Berlese (**2**) states that this fungus is in his opinion a *Teichospora* and Fabre himself in his original description of the species says that it would have been placed in the genus *Teichospora* if the perithecia had been scattered instead of being massed together.

11. CUCURBITARIA MEZEREI Cooke, Grevillea **15**: 86. 1886

Sphaeria Mezerei Schw. Trans. Am. Phil. Soc. II. **4**: 205. 1832.

This is one of 8 forms listed by Cooke (l.c.) as "*species incertae.*" Material has not been examined.

12. CUCURBITARIA MOLLIUSCULA Cooke, Grevillea **15**: 86. 1886

Sphaeria molliuscula Schw. Trans. Am. Phil. Soc. II. **4**: 204. 1832.

Hypocrea molliuscula Sacc. Syll. Fung. **2**: 536. 1883.

This is one of the 8 forms listed by Cooke (l.c.) as "*species incertae.*" Material has not been examined.

13. CUCURBITARIA NIDULA (Sowerby) Cooke, Grevillea **15**: 86. 1886

Sphaeria nidula Sowerby, Coloured Figures of English Fungi. *pl. 394. fig. 2.* 1803. Fries, Syst. Myc. **2**: 418. 1823.

This is one of 8 forms listed by Cooke (l.c.) as "*species incertae.*" The authorship of the species is incorrectly attributed to Schweinitz. Material has not been examined.

14. CUCURBITARIA OCCULTATA (Fries) Oudemans, Arch. Néerl. Sci. **8**: 404. 1873

Sphaeria occultata Fries, Elench. Fung. **2**: 72. 1828.

Sphaeria rugosa Wallr. Fl. Crypt. Ger. **4**: 780. 1833.

Gibberidea occultata O. Kuntze, Rev. Gen. Pl. 3²: 481. 1898.

No specimens referred to this species have been seen. The type was collected on *Syringa vulgaris*. Brenckle (**3**) reports a collection on *Shepherdia vulgaris* in North Dakota. For want of further evidence regarding its character this species must be regarded as doubtful.

15. CUCURBITARIA PARASITANS Cooke, Grevillea **15**: 86. 1886
Sphaeria parasitans Schw. Trans. Am. Phil. Soc. II. **4**: 206. 1832.

This is one of the 8 forms listed by Cooke (l.c.) as "*species incertae*." Material has not been examined.

16. CUCURBITARIA RADICALIS Cooke, Grevillea **7**: 51. 1878
Coelosphaeria radicalis Sacc. Syll. **1**: 93. 1882.
(?) *Dothiorella radicalis* Ellis & Ev. N. Am. Pyrenom. 244. 1892.
Gibberidea radicalis O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.
Nitschkia radicalis O. Kuntze, l.c. 501.

See Fitzpatrick (**23**).

17. CUCURBITARIA RAVENELII Cooke & Massee, Grevillea **16**: 25. 1887
Gibberidea Ravenelii O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

This species was described from a specimen collected on *Ailanthus glandulosa* at Aiken, South Carolina, by Ravenel. The material in the herbarium of Cooke, now at the Royal Botanical Gardens at Kew, was obtained for study but was found to be worthless. No other collections from *Ailanthus* are known. The host for *C. Ailanthi* Rabenhorst has been shown by Winter (**68**) to have been *Acer Negundo.*

18. CUCURBITARIA ROSAE Wint. & Sacc. Michelia **1**: 408. 1879
Gibberidea Rosae O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

This species seems never to have been well understood. The examination of the material supposed to have been the type from Saccardo's Herbarium failed to shed any further light on the matter. One specimen shows only pycnidia in a Valsaceous stroma, another, in the Saccardo collection from the herbarium of de Thümen, shows no asci or spores and a third from the herbarium of G. Winter gives hyaline muriform spores. Saccardo himself admitted the doubtful character of this species (**55**). Berlese (**2**) suggested affinities with *Pleospora*. Fairman (**21**) cites a collection from New Mexico but questions the determination.

19. CUCURBITARIA SALICINA Fuckel, Symb. Myc. 172. 1869

Gibberidea salicina O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The specimen distributed under this name, No. *1616* Fungi Columbiani, is the only American specimen seen. A section through the perithecium shows a clypeus present. This specimen is therefore to be referred to the genus *Phaeopeltosphaeria*. A specimen from Petrak (Flora Moravica) appears to be different from the above and has spores 28–31 × 12–14 μ and mostly 7-septate. According to Fuckel (l.c.) *C. salicina* has spores 22 × 9 μ and 4–5-septate.

20. CUCURBITARIA SHEPHERDIAE (Ellis & Ev.) Ellis & Ev. North American Pyrenom. 241. 1892

Curreya Shepherdiae Ellis & Ev. Proc. Acad. Phila. **1890**: 249. 1890.

The type specimen in the Ellis collection at the New York Botanical Garden has been largely destroyed by insects. A specimen received from Brenckle, No. *1191* on *Shepherdia argentea*, collected at Kulm, North Dakota, has been examined and the perithecia are seen in section to be single and to lack a stroma, being seated directly on the cortical tissue. Theissen and Sydow (**62**) in their revision of the Dothideales assert that from its description this species seems to be a good *Curreya*. They did not examine material.

21. CUCURBITARIA SPARTII (Nees.) Ces. & de-Not. Comm. Soc. Critt. Ital. **1**: 214. 1863

Sphaeria Spartii Nees in Fries, Syst. Myc. **2**: 424. 1823.
Gibberidea Spartii O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The type of this species has not been seen and except for the record of a single collection at Newfield, N. J. (Ellis **16**), no references to American specimens have been found. The Ellis specimen is not present in the collection at the New York Botanical

Garden nor was it distributed in any of the exsiccati sets sent out by Ellis. A number of specimens from European exsiccati have been examined and it seems evident that this species can be separated from *C. elongata* only with difficulty. Lacking further evidence as to the type specimen and as to the occurrence of the species in North America the placing of this species in the doubtful group is necessary.

22. CUCURBITARIA STENOCARPA Ellis & Ev. Proc. Acad. Phila. **1895**: 420. 1896

Gibberidea stenocarpa O Kuntze, Rev. Gen. Pl. **3^2**: 481. 1898.

This species is known only from the type collection and the material in the Ellis Herbarium at the New York Botanical Garden is in very poor condition. It appears to have been immature when collected, which may account for the difference noted between this species and *C. typhina* Ellis & Ev. on *Rhus typhina*.

23. CUCURBITARIA STIPATA Cooke, Grevillea **15**: 86. 1886

Sphaeria stipata Schw. Trans. Am. Phil. Soc. II. **4**: 205. 1832.

This is one of 8 forms listed by Cooke (l.c.) as "*species incertae.*" Material has not been examined.

24. CUCURBITARIA ULMICOLA Fuckel, Symb. Myc. 172. 1869

Gibberidea ulmicola O. Kuntze, Rev. Gen. Pl. **3^2**: 481. 1898.

The specimens distributed under this name in Ellis and Everhart's North American Fungi *2815* and another collection in the Ellis Herbarium at the New York Botanical Garden have been examined. These specimens are similar but they do not represent the genus *Cucurbitaria*, being without stromatic basal portion or subiculum. European material has not been available for comparison. The spores in the American specimens (46–48 × 15 μ) are larger than the spores of the European *C. ulmicola* (36 × 14 μ) and it is not likely that these are the same. The occurrence of this name in the literature of North American fungi may therefore be attributed to the incorrect determination of these specimens by Ellis.

25. CUCURBITARIA VARIA Cooke, Grevillea **15**: 86. 1886

Sphaeria varia Pers. Syn. Fung. 52. 1801.

This is one of the 8 forms listed by Cooke (l.c.) as "*species incertae.*" Material has not been examined.

II. EXCLUDED SPECIES

A. AMPHISPHAERIACEAE

The following species have been excluded from the genus by reason of the fact that they all lack the turbinate character of the perithecium and a stroma or stromatic subiculum is wholly wanting, the perithecia being partially sunken in the host tissue. This group appears to be most closely related to the Amphisphaeriaceae. Some of the species have already been referred by others to the genus *Teichospora.*

1. CUCURBITARIA BOREALIS Ellis & Ev. Proc. Acad. Phila. **1894**: 334. 1895

Gibberidea borealis O. Kuntze, Rev. Gen. Pl. **3**²: 481. 1898.

The type specimen was published as Shear's N. Y. Fungi *216.* This has been examined at the New York Botanical Garden.

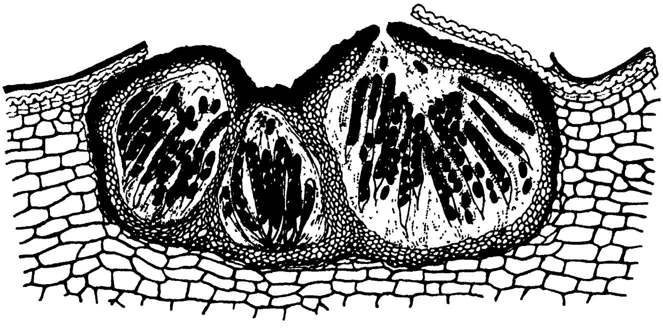

FIG. 1. *Cucurbitaria borealis.* Longitudinal section showing the relationship of the fungus to the cortical tissue of the host, *Salix* sp. (Outlined with a projection camera; × 87.) Type material.

2. CUCURBITARIA CELTIDIS Shear, Bull. Torrey Club **29**: 451. 1902

Material from the herbarium of C. L. Shear No. *383* was studied. Shear in his original description (**59**) stated that the fungus was first referred to *Teichospora* but was finally called *Cucurbitaria* in deference to Doctor Rehm to whom specimens were submitted.

3. CUCURBITARIA COREMAE Ellis & Ev. Bull. Torrey Club **10**: 89. 1883

Gibberidea Coremae O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.

According to Berlese (2) this is a *Teichospora.* The type specimen in the Ellis Herbarium at the New York Botanical Garden has been seen and is certainly not a *Cucurbitaria.* The original collection was made on *Hudsonia tomentosa*, the host having been mistaken for *Corema Conradii.*

4. CUCURBITARIA INSECURA Ellis (?), Bull. Torrey Club **9**: 1882

Teichospora insecura Ellis & Ev. N. Am. Pyrenom. 214. 1892.
Gibberidea insecura O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.

The original publication of this species has not been found. The citation given above appears on the packet in North American Fungi No. *882*. The description is not to be found in the place cited.

5. CUCURBITARIA JUGLANDINA Ellis & Barth. Jour. Myc. **8**: 174. 1902

The type of this species was published as Kansas Fungi No. *2939*. A specimen of this was obtained through the kindness of Mr. E. Bartholomew. The cespitose habit, 5–10 perithecia in a cluster, as described in the original publication was not evident in this specimen.

6. CUCURBITARIA SOLITARIS Ellis, Bull. Torrey Club **8**: 125. 1881

Teichospora solitaria Ellis & Ev. N. Am. Pyrenom. 214. 1892.
Gibberidea solitaria O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.
See Ellis and Everhart (**16**).

7. CUCURBITARIA TYPHINA Ellis & Ev. Jour. Myc. **9**: 166. 1903

The type specimen of this fungus was kindly supplied by Mr. E. Bartholomew. The thick-walled perithecia are immersed only when very young and become erumpent before maturity, the basal portion remaining sunken. There is no thickening at the base of the perithecia, which appear to have been formed above empty pycnidial cavities, the latter having become shrunken and flattened by the growth of the perithecia.

B. SPHAERIACEAE

The following species lack a typical stroma or subiculum and their superficial habit indicates a closer relationship to the Sphaeriaceae than to the Cucurbitariaceae. Since the Sphaeriaceae contains at this time no well defined genus with muriform spores suitable to absorb this group, no definite placing of these forms can be made at this time.

8. CUCURBITARIA CASSANDRAE Ellis in herb.

This species was never published and is known only from the specimen to be found in the Ellis collection at the New York Botanical Garden. The perithecia are small and erumpent, with rather prominent ostiola. This species is obviously related to *C. rimulina* Fairman.

9. CUCURBITARIA COMPTONIAE Cooke & Ellis, Grevillea **6**: 12. 1877

Gibberidea Comptoniae O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Four specimens from the collection of Ellis have been available for the study of this species. These have been supplemented by collections made by the writer in Ithaca, New York, and at Ausable Forks, New York, both on *Comptonia asplenifolia.* The perithecia occur singly or in groups and in most cases when they appear to be erumpent they appear above the bark only where the bark has split from other causes. Winter (**67**) has described a species which he calls *C. setosa* on *Myrica germanica.* From his description these seem to be similar but no material of the European specimens could be obtained for study or further comparison.

10. CUCURBITARIA CONGESTA Cooke & Ellis, Grevillea **6**: 12. 1877

Gibberidea congesta O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

This species is known only from the collections of Ellis of which there are six specimens in the herbarium of the New York Botanical Garden. The collections were all made at Newfield, New Jersey, on *Magnolia*. The specimens are all very similar, the perithecia being seated on the bare wood in wounds or open places. Careful sectioning reveals that the perithecia are single and closely attached to the substratum. In habit this fungus shows distinct relationships with *C. Comptoniae*.

11. CUCURBITARIA CRATAEGI (Schw.) Ellis & Ev. N. Am. Pyrenom. 240. 1892. (Not *C. Crataegi* Niessl.)

Sphaeria Crataegi Schw. Trans. Am. Phil. Soc. II. **4**: 207. 1832.
Gibberidea Crataegi O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.

The type specimen of *Sphaeria Crataegi* from the herbarium of Schweinitz has been examined and compared with the specimen in the Ellis collection at the New York Botanical Garden. Specimens were also received from Brenckle, *526* and *1195* North Dakota Fungi. All of the specimens examined are very much alike. The description of this species by Ellis (l.c.) is based partly on an examination of the Schweinitz specimen part of which appears to have been immature, since the spores are said to be yellow. It appears that the species described by Niessl (**43**) may be the same although Ellis (**16**) states that it is different, and Berlese (**2**) cites *C. Crataegi* Niessl as a synonym of *Fenestella princeps*.

12. CUCURBITARIA DELITESCENS Sacc. Michelia **2**: 252. 1882

Gibberidea delitescens O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.

This species was originally described on *Persica vulgaris*. The type has not been seen but several specimens have been examined including a form collected by Brenckle on *Rubus strigosus* in North Dakota and another collected on *Prunus spinosa* by Petrak in Czechoslovakia. Morgan (**42**) also reports finding this species on *Persica vulgaris* in Ohio. This fungus is closely related to *C. Ribis* and like that species is excluded from the genus *Cucurbitaria* because of the shape of the perithecium and character of the underlying fungous tissue.

13. CUCURBITARIA ELLISII Sacc. & Syd. Syll. Fung. **14**: 607. 1899

Cucurbitaria Astragali Ellis & Ev. Bull. Torrey Club **24**: 127. 1897 (not *C. Astragali* Karsten & Hariot, Rev. Myc. **12**: 171. 1890).

Gibberidea Astragali O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

Type material from the herbarium of Ellis was used in the study of this species. It was found that this fungus had no thickened basal portion and no pronounced underlying stroma or subiculum. Type material of the European form, *C. Astragali* Karst. & Hariot, was not obtained for comparison but from the several published descriptions of the latter it is concluded that Saccardo was justified in assuming that the European and American species on *Astragalus* are not the same. According to Saccardo the European fungus has spores 3–7-septate while Berlese (2) in his description based on material received from Hariot states definitely that the spores are 7-septate. The illustration presented by Berlese shows the spores of the Hariot fungus to be quite different from those found in the American specimen.

14. CUCURBITARIA LONGITUDINALIS Peck, Ann. Rep. N. Y. State Mus. **33**: 34. 1880

Gibberidea longitudinalis O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The type of this species has been examined. The perithecia are erumpent in irregular rows running longitudinally in the bark and superficially resemble *C. Berberidis*. This fungus has no structure at all corresponding to the stroma or subiculum of the species of *Cucurbitaria*. The structure of the perithecia also indicates that this does not belong to this group. The walls are composed of two distinct layers, the outer layer is black and as far as could be seen in thin sections it has no cellular structure. The inner layer is hyaline or yellowish and composed of rather thick-walled cells.

15. CUCURBITARIA MINIMA Ellis & Ev. Bull. Torrey Club **24**: 460. 1897

Sections of the type specimen from the Ellis collection at the New York Botanical Garden demonstrated the fact that the perithecia are here seated directly upon the bare wood. In thin sections the hyphae may be seen penetrating the wood from the base of the perithecia. This species is with difficulty separated from *C. Ribis*.

16. CUCURBITARIA NAUCOSA (Fries) Fuckel, Symb. Myc. 173. 1869

Sphaeria naucosa Fries in Kunze & Schmidt, Myk. Hefte **2**: 36. 1823.

Cenangium naucosum Fries, Summa Veg. Scand. 364. 1849.

Gibberidea naucosa O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The original material from the Fries Herbarium has been compared with a specimen from the collection of Fuckel. These fungi are not the same and neither is a good *Cucurbitaria*. They both show characters which would place them in the Sphaeriaceae. The only American collection of which there is a record is that of Schweinitz on elm (?) at Bethlehem, Pennsylvania. Ellis has examined this specimen and reports (**16**) that it is too poor to allow him to express an opinion as to what it might have been.

17. CUCURBITARIA QUERCINA Ellis & Ev. Bull. Torrey Club **24**: 460. 1897

The type specimen, collected by Bethel on dead limbs of *Quercus undulata*, has been examined.

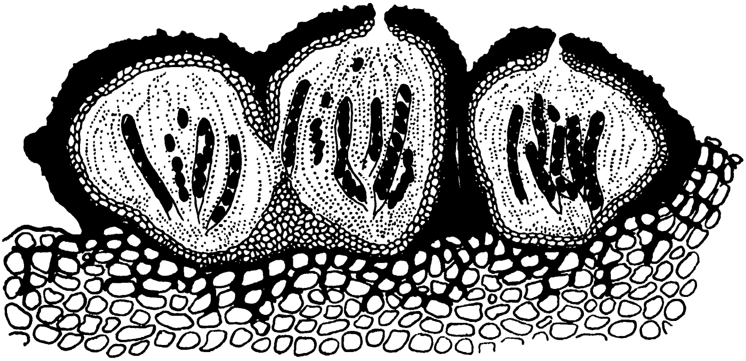

FIG. 2. *Cucurbitaria quercina.* Longitudinal section showing the position of the perithecia relative to the cortical tissue of the host, *Quercus* sp. (Outlined with a projection camera; × 135.) Type material.

18. CUCURBITARIA RIBIS Niessl, Verh. Naturfor. Ver. Brünn **10**: 198. 1871

Gibberidea Ribis O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.

In this species the perithecia are found mostly on the decorticated wood. Type material has not been studied but numerous exsiccati specimens have been available. From the examination of these it is clear that this species is not a *Cucurbitaria*. Other species which have characters closely resembling this fungus are *C. minima* Ellis & Ev. and *C. delitescens*.

19. CUCURBITARIA RIMULINA Fairman, Proc. Rochester Acad. Sci. **6**: 129. 1922

The perithecia in this species are flask-shaped with prominent necks. They show no thickening at the base and are seated directly on a mass of dark hyphae, loosely woven, suggesting the hyphoid subiculum of the species of *Cucurbitaria* described elsewhere. Doctor Fairman kindly sent type material from his herbarium for the purpose of this study.

20. CUCURBITARIA SORBI Karst. Myc. Fenn. **2**: 62. 1873

Gibberidea Sorbi O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.

Type material from the herbarium of Karsten was examined. This specimen appeared to be identical with a specimen collected by the writer on *Sorbus americana* in Northern New York. The large hairy perithecia are in cespitose clusters without enlarged

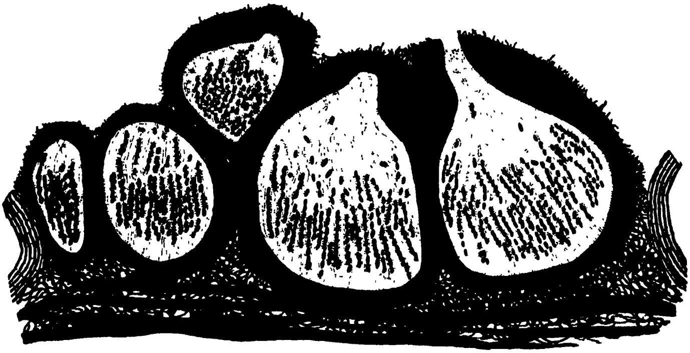

FIG. 3. *Cucurbitaria Sorbi*, on *Sorbus* sp. Longitudinal section of a group of perithecia. (Outlined with a projection camera; × 40.) Type material.

basal portion. The walls are relatively thin compared with species of *Cucurbitaria* and of uniform thickness at the basal portion, thickened around the prominent ostiola.

21. CUCURBITARIA UMBILICATA Ellis, Bull. Torrey Club **10**: 53. 1883

Gibberidea umbilicata O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.

Two specimens of this fungus, one of which is the type, were examined in the Ellis collection at the New York Botanical Garden. The perithecia are scattered and occur on the decorticated wood. The opinion is expressed by Berlese (**2**) that this fungus is a *Teichospora* related to *T. pomiformis*. In the specimens examined the perithecia are not at all imbedded at the base and there seems to be no reason for placing this species in the Amphisphaeriaceae.

C. OTHER EXCLUDED SPECIES

The following group includes (1) species of various affinities and (2) recognized synonyms.

22. CUCURBITARIA ALNEA Peck, Ann. Rep. N. Y. State Mus. **28**: 75. 1876

Otthia alnea Sacc. Syll. Fung. **1**: 740. 1822.

An examination of the type specimen verified the findings of Saccardo. The spores are hyaline and two-celled.

23. CUCURBITARIA BIGELOVIAE Ellis in herb.

This specimen, collected in Colorado on *Bigelovia graveolens* by Bethel (No. *236*), was found in the Ellis collection at the New York Botanical Garden. The species was never published. The spores are olive-brown, mostly 4-septate and the perithecia possess the characteristic stalk of the *Cucurbitaria* type. The spores are not muriform and the species should therefore be placed in the genus *Gibberidea* Fuckel.

24. CUCURBITARIA BREVIBARBATA Berk. & Curt. Grevillea **4**: 47. 1876

Fracchiaea brevibarbata Sacc. Syll. Fung. **1**: 94. 1882.

Fracchiaea heterogenea Sacc. Mycol. Ven. Spec. Atti Soc. Veneto-Trent. Sci. Nat. **2**: 163. 1873.

See Fitzpatrick (**24**).

25. CUCURBITARIA CALLISTA Berk. & Curt. Grevillea **4**: 47. 1876

Fracchiaea callista Sacc. Syll. Fung. **1**: 94. 1882.
Sphaeria callista Berk. & Curt. (nom. nud.) in Rav. Fung. Car. **5**: 67. 1860.
See Fitzpatrick (**24**).

26. CUCURBITARIA CEANOTHI Dearness & House, Bull. N. Y. State Mus. **188**: 29. 1916

Material of this species collected at Albany, New York, by Doctor H. D. House and determined by him to be the same as the original collection was available for study. The perithecia in section were found to be entirely immersed in the host tissue and to possess no stroma. The walls of the perithecia were thin, this character in connection with the habit above mentioned indicating affinities with *Pleospora*.

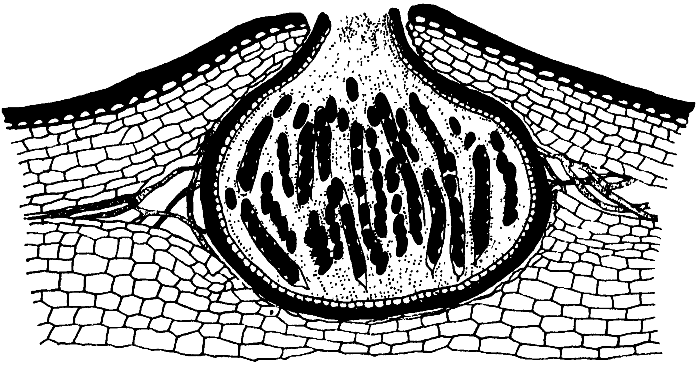

FIG. 4. *Cucurbitaria Ceanothi* on *Ceanothus americanus*. Longitudinal section of single perithecium imbedded in the cortical tissue of the host. (Outlined with a projection camera; × 120.) Type material.

27. CUCURBITARIA CINNABARINA Grev. Scottish Crypt. Fl. **3**: *pl. 135*. 1825

Nectria cinnabarina (Tode) Fries, Summa Veg. Scand. 388. 1849.
(*Sphaeria cinnabarina* Tode, Fung. Mekl. **2**: 9. 1791.)

28. CUCURBITARIA CITRICOLA Sturgis. In Ellis Herb.

This specimen was found in the Ellis collection at the New York Botanical Garden. It was collected by Sturgis from *living* orange trees at Grasum, Florida. A careful examination has shown that the fungus is growing upon scale insects rather than the orange tree. Another similar case is seen in the species *Cucurbitaria pithyophila* (Fries) de-Not. which Petrak (**49**) has recently placed in the new genus *Cucurbidothis*. The Ellis specimen was never used in publication.

29. CUCURBITARIA COCCINEA S. F. Gray, Nat. Arr. Brit. Pl. **1**: 519. 1821

Nectria coccinea Fr. Summa Veg. Scand. 388. 1849.

30. CUCURBITARIA CONFLUENS Plowr. Grevillea **5**: 74. 1876

Gibberidea confluens O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The original specimen of this species was collected by Harkness in the Sierra Nevada Mountains, California. The type material from the herbarium of Cooke has been examined and it was found to possess a clypeus. This places the fungus in the Clypeosphaeriaceae in the genus *Phaeopeltosphaeria*.

31. CUCURBITARIA CONGLOBATA (Fries) Ces. & de-Not. var. CRATAEGI Rehm

This name appeared in a list of fungi published by Brenckle (**3**). The fungus had previously been sent to Rehm who suggested this name but it was never published. Specimens from the herbarium of Brenckle and a specimen from the Rehm collection

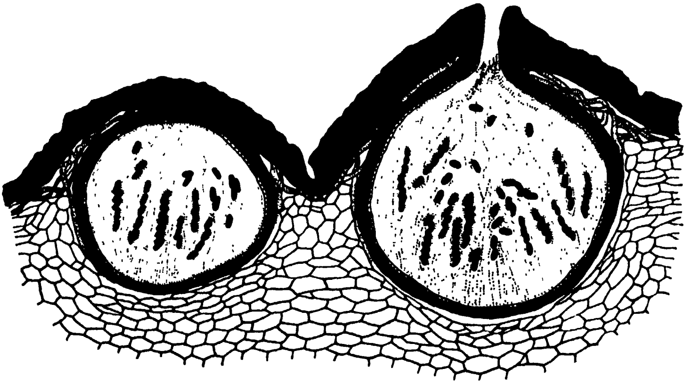

FIG. 5. *Cucurbitaria confluens*, on *Quercus* sp. Longitudinal section of two perithecia showing the clypeus, in this case continuous. (Outlined with a projection camera; × 85.) Type material.

have been examined. The spores are found not to be muriform and the species is therefore to be referred to the genus *Gibberidea.*

32. CUCURBITARIA CUPULARIS Gray, Nat. Arr. Brit. Pl. **1**: 519. 1821

Nitschkia cupularis Karst. Myc. Fenn. **2**: 81. 1873.
See Fitzpatrick (**23**).

33. CUCURBITARIA ECHINATA Ellis & Ev. N. Am. Pyrenom. 240. 1892

Cucurbitaria setosa Ellis & Ev. (not Winter) Proc. Acad. Phila. **1890**: 241. 1890.
Berlesiella setosa Sacc. Syll. Fung. **9**: 915. 1891.
Gibberidea setosa O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.

The original species name of this fungus was changed by Ellis and Everhart because of the existence of the homonym *Cucurbitaria setosa* Winter (**67**). Saccardo (**56**) determined that the Ellis fungus was not a *Cucurbitaria* and he established the new genus *Berlesiella* on this species. That Ellis had some doubt about this being a good *Cucurbitaria* is shown by the fact that the type specimen in the Ellis collection at the New York Botanical Garden is accompanied by notes and a fully written description of a new genus *Dearnessia* which was never published.

34. CUCURBITARIA ERRATICA Peck, Bull. Torrey Club **34**: 349. 1907

Type material from the Peck collection at the New York State Museum was available for study. Sections of the perithecia indicated a *Cucurbitaria*-like formation, thickened base resting on a heavy subiculum. The perithecia are distinctly hairy, the ascus walls are very thick and gelatinous and paraphyses are entirely absent. Saccardo (**56**) has suggested for this fungus the genus name *Peckiomyces.* A specimen collected by Brenckle, No. *1411*, on *Prunus melanocarpa* in North Dakota seems to be the same fungus.

35. CUCURBITARIA FRAXINI var. EFFUSA Ellis & Ev. N. Am. Pyrenom. 730. 1892

In the type specimen the perithecia are completely imbedded in a loose stroma composed of the altered cortical tissue and there are empty pycnidial chambers which have long necks leading to the surface. According to these observations this species belongs to the genus *Fenestella*.

36. CUCURBITARIA MACILENTA Cooke, Grevillea **7**: 4. 1878

Wallrothiella macilenta Sacc. Syll. Fung. **1**: 455. 1882.

37. CUCURBITARIA MORBOSA (Schw.) Ellis, N. Am. Fungi No. *691*. 1881

Sphaeria morbosa Schw. Schr. Nat. Ges. Leipzig **1**: 40. 1822. Fries, Syst. Myc. **2**: 417. 1823.
Plowrightia morbosa Sacc. Syll. Fung. **2**: 638. 1883.
Otthia morbosa Ellis & Ev. N. Am. Pyrenom. 251. 1892.
Dibotryon morbosum Theiss. & Syd. Ann. Myc. **13**: 663. 1915.

Cucurbitaria morbosa (Schw.) Ellis appears never to have been published as a name except on the packet label of Ellis, N. Am. Fungi *691*.

38. CUCURBITARIA OCCIDENTALIS Ellis, Bull. Torrey Club **8**: 125. 1881

Melanomma occidentale Sacc. Syll. Fung. **2**: 111. 1823.

Examination of the type material verifies the placing of this fungus in the genus *Melanomma*.

39. CUCURBITARIA PITHYOPHILA (Fries) Ces. & de-Not. Comm. Soc. Critt. Ital. **1**: 214. 1863

Sphaeria pithyophila Fries, Syst. Myc. **2**: 425. 1823.
Gibberidea pithyophila O. Kuntze, Rev. Gen. Pl. **3**^{2}: 481. 1898.
Cucurbidothis pithyophila Petrak, Ann. Myc. **19**: 198. 1921.

This species has been treated extensively by Petrak (**49**) as a member of the Dothideales.

40. CUCURBITARIA PUBENS (Schw.) Cooke, Grevillea **15**: 85. 1887

Sphaeria pubens Schw. Trans. Am. Phil. Soc. II. **4**: 205. 1832.

Cooke (l.c.) lists it in the section "*Sporidia 4-pluriseptata.*" In the Farlow Index it is referred to *Camarosporium pubens* (S.) n.n.

41. CUCURBITARIA SERIATA Peck, Ann. Rep. New York State Mus. **28**: 75. 1876

Otthia seriata Sacc. Syll. Fung. **1**: 739. 1882.

A part of the type collection has been examined and found to possess hyaline, 2-celled spores. The fungus is referred to *Otthia*.

42. CUCURBITARIA TUMORUM (Schw.) Berk. Grevillea **4**: 47. 1876

Sphaeria tumorum Schw. Trans. Am. Phil. Soc. II. **4**: 204. 1832.
Diplodia tumorum Ellis & Ev. North Am. Pyrenom. 243. 1892.
Gibberidea tumorum O. Kuntze, Rev. Gen. Pl. 3^2: 481. 1898.

Material of this species was examined by Ellis (**16**) in Herb. Schweinitz and only stylospores of a *Diplodia* were found. A specimen in the herbarium of Curtis at Harvard is marked in Farlow's hand, "*shows nothing.*"

43. CUCURBITARIA VAGANS Sacc. Myc. Venet. 122. 1873

This fungus is cited by Berlese (**2**) and by Winter (**68**) as a synonym of *Fenestella vestita* (Fries) Sacc. The type specimen has not been examined but a specimen in Fungi Rhen., *954*, is found to be Valsoid. The material distributed in Rabenhorst, Fungi Europaei, is another fungus appearing much like a *Cucurbitaria*.

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EXPLANATION OF PLATE 7

Fig. 1. *C. Berberidis*, longitudinal section through a group of young perithecia. × 60. Type material.

Fig. 2. *C. Laburni*, longitudinal section through a group of mature perithecia. × 37. Type material.

Fig. 3. *C. elongata*, longitudinal section through a group of mature perithecia. × 60. Type material.

EXPLANATION OF PLATE 8

Fig. 4. *C. Caraganae*, longitudinal section through a group of mature perithecia. × 37. Type material.

Fig. 5. *C. Berberidis*, longitudinal section through a mature perithecium. × 60.

Fig. 6. *C. arizonica*, longitudinal section through a group of mature perithecia. × 60. Type material.

Fig. 7. *Crotonocarpia moriformis*, longitudinal section through a group of perithecia. × 60. Type material.

Fig. 8. *Teichospora Morthieri*, longitudinal section through a single perithecium. × 60. Type material.

Fig. 9. *Cucurbitaria Berberidis*, single ascus with spores. × 400. Type material.

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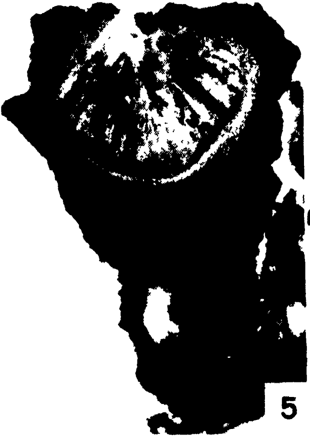
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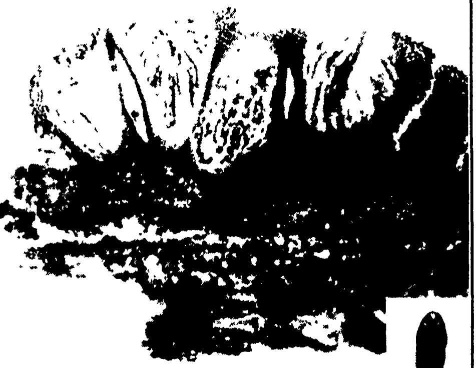
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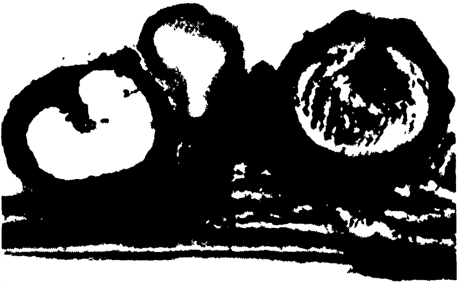
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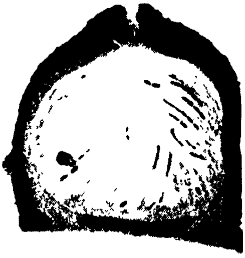
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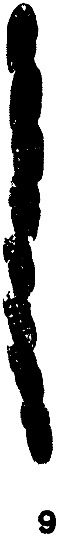
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4 6, 9. CUCURBITARIA
7. CROTONOCARPIA
8. TEICHOSPORA

NOTES ON THE USTILAGINEAE OF WASHINGTON

GEORGE L. ZUNDEL

The writer in 1919 published [1] a rather complete list of the Ustilaginales of Washington but since then more information relative to the distribution and host plants of several species has been collected. The purpose of this paper is to record this newly collected data.

1. TILLETIA GUYOTIANA Hariot, Jour. de Bot. 14: 117. 1900.

This species was first described by Hariot in 1887 as *Thecaphora guyotiana* but in 1900 he changed the name to *Tilletia guyotiana.* The smut was first reported from North America by the writer [1] in 1919 who reported it from Klickitat and Walla Walla counties, Washington. Since that time the following additional collections have been made:

On *Bromus hordeaceus* L.

(*a*) Endicott, Whitman County, Washington, July 14, 1920 (rare), collected by George L. Zundel.

(*b*) Campus of the State College of Washington, Pullman, Whitman County, Washington, July 3, 1921 (rare), collected by Zundel.

(*c*) Pullman, Whitman County, Washington, south on hillside, July 30, 1921 (rare), collected by Zundel.

(*d*) Moscow, Latah County, Idaho; 2 miles south of Cedar Mountain on foothills of Moscow Mountains (25–85 per cent infection), October 3, 1925, collected by George L. Zundel and E. E. Honey. This is the first recorded collection of this smut from the state of Idaho.

(*e*) Garfield, Whitman County, Washington, south ½ mile on Colfax road (25–98 per cent infection) October 8, 1925, collected by Zundel.

2. TILLETIA RAUWENHOFFII Fisch. v. Waldh. Aperçu Syst. Ust. 50. 1877.

Syn. *Tilletia Holci* (Westend.) Rostrup. 1913.

This smut has been reported from Belgium, Denmark, Great Britain, New Zealand. In 1919 Jackson reported it from Oregon and the writer reported it from Cowlitz County, Washington, in the paper[1] to which reference has already been made. Since then, this smut has been found in the following new localities:

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[1] ZUNDEL, GEORGE L., Some Ustilagineae of the State of Washington, Mycologia **12**: 275–281. 1919.

On *Holcus lanatus* L. [*Nothoholcus lanatus* (L.) Nash].

(*a*) Near city dock, Anacortes, Skagit County, Washington, July 2, 1924 (rare), collected by Zundel.

(*b*) On Great Northern right-of-way, Mt. Vernon, Skagit County, Washington, July 2, 1924 (rare), collected by Zundel.

(*c*) West of Mt. Vernon 1½ miles, Skagit County, Washington, July 2, 1924 (rare), collected by Zundel.

3. USTILAGO BROMIVORA (Tul.) Fisch. v. Waldh. Bull. Soc. Nat. Mosc. **40**^{1}: 252. 1867.

This smut is very common on the genus *Bromus* in Washington but not until recently has it been collected on *Bromus tectorum*. The following collections have been made during 1924 and 1925:

On *Bromus tectorum* L.

(*a*) Oroville, Okanogan County, Washington. ¾ mile north on Great Northern Railroad, June 29, 1924 (rare), collected by Zundel.

(*b*) Sharon, Spokane County, Washington, July 31, 1924 (rare), collected by Zundel.

(*c*) Pleasant Prairie, Spokane County, Washington, August 1, 1924 (rare), collected by Zundel.

(*d*) Foothills, Spokane County, Washington, August 1, 1924 (rare), collected by Zundel.

(*e*) Pasco, Franklin County, Washington, on the farm of H. A. Small (rare), August 19, 1924, collected by Zundel.

(*f*) Pullman, Whitman County, Washington, September 10, 1924 (rare), collected by A. Floyd Heck. (Plant Path. Herb. No. C. S. *1469.*)

(*g*) Side of highway, South Moran, Spokane County, Washington, July 31, 1924 (rare), collected by Zundel.

(*h*) Mill Creek, Walla Walla County, Washington, August 13, 1925 (rare), collected by Zundel.

(*i*) West side of State College of Washington Campus, Pullman, Washington, Whitman County, August 19, 1925 (very rare), collected by Zundel.

(*j*) Upper Blue Creek, Walla Walla County, Washington, August 21, 1925 (10–85 per cent infection), collected by Zundel.

(*k*) Foot of Badger Mountain, 2 miles s.w. of Waterville, Douglas County, Washington, September 10, 1925 (25–40 per cent infection), collected by George L. Zundel and C. E. Hill.

(*l*) McGee flats, west of Silver Lake, Pullman, Whitman County, Washington (rare), September 22, 1925, collected by Zundel.

(*m*) South ½ mile on Northern Pacific railway, Pullman, Whitman County, Washington, October 2, 1925 (one panicle smutted), collected by Zundel.

(*n*) Little Almota Creek Canyon, Almota, Whitman County, Washington, October 10, 1925, collected by E. E. Honey:

Ustilago bromivora macrospora Farlow has previously been reported from Lake Chelan, Chelan County, Washington, on *Bromus tectorum* L. by Weir. (Weir No. *12496*.)

4. SPHACELOTHECA HYDROPIPERIS (Schum.) de Bary, Vergl. Morph. Biol. Pilze 187. 1884.

On *Polygonum hydropiperoides* Michx. var. *psilostachya* H. St. John, Seaview, Pacific County, Washington, July 11, 1924. Common in ditches and ponds of the cranberry bogs. Collected by George L. Zundel and D. J. Crowley. (Host was determined by H. St. John of the Botany Department.)

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THE PROBLEM OF TERMINOLOGY IN THE RUSTS[1]

J. C. Arthur and F. D. Kern

There is today more or less confusion regarding the use of terms for the various vegetative and fruiting structures in the plant rusts. Twenty years ago the senior author pointed out (Bot. Gaz. **39**: 219–222. 1905) that the terminology then in use was "clumsy, ambiguous, poorly correlated, and quite inadequate to show homologies properly." This remark referred to the old terms *aecidium*, *uredo*, *teleuto*, etc., and their derivatives. At that time the terms *aecium*, *uredinium*, *telium*, etc., were proposed. These newer terms have been more or less widely used, but there has not been the uniformity in their application which is desirable. While the newer terms resemble the older ones they are not identical with them and are not designed merely to replace them. It is believed that the newer terms have a significance never possessed by the older terms and which the older terms cannot now be made to assume. But a matter of far more fundamental importance than the selection of the terms themselves is the outlining of concepts which are to be the basis for applying terms. For the sake of brevity it seems possible to develop a number of conceptions in the form of dicta. They are as follows:

1. The conception of rusts should give consideration both to the vegetative body (mycelium) and to the fruiting structures (sori) which arise from it.

2. The vegetative body is either long-cycle (macrocyclic), consisting of two unlike and discontinuous generations, or short-cycle (microcyclic), consisting of one continuous generation.

3. The fruiting structures, the sori, containing spores that are either inefficient, having no capacity to bring about infection, or efficient, containing spores having the capacity to bring about infection.

4. The inefficient sori (pycnia) are present or absent in both

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[1] Read before the Mycological Section of the Botanical Society of America at the Kansas City meeting, December 30, 1925.

Joint contribution from the Botanical Department of Purdue University Agricultural Experiment Station and the Botanical Department of the Pennsylvania State College.

macrocyclic and microcyclic rusts, in the former only with the first generation.

5. The sori with efficient spores in a macrocyclic rust are the essential initial forms (aecia) and the essential final forms (telia), with which may or may not be associated intermediate repeating forms (uredinia); the efficient sori in a microcyclic rust resemble either the macrocyclic aecia or they resemble the macrocyclic telia, and may be designated by the same terms.

While some of these principles have been generally recognized they have not been formulated heretofore in this manner.

The point brought out in the first dictum does not need detailed elaboration. It is intended merely to draw attention to the fact that we often fall into the habit of talking about rusts as if they were collections of sori, instead of minute plants bearing fruiting structures.

For some time it has been recognized that rusts may be divided into two classes: (1) long-cycle and (2) short-cycle. We are indebted to Dr. G. Lagerheim, of Stockholm, for the suggestion of the terms *macrocyclic* and *microcyclic* which seem to us to be very appropriate and satisfactory. Heretofore, the separation into these two classes usually has been on the basis of the spore-forms produced. The second dictum points out that the logical separation is on the basis of the vegetative body. It is believed that as here stated it should be acceptable to most mycologists. A macrocyclic rust is said to have two unlike and discontinuous generations. The question whether these represent gametophyte and sporophyte need not be settled in order to permit a satisfactory arrangement of our terminology. The same is true regarding the nature of the single continuous generation in the microcyclic rusts.

In the third dictum it is pointed out that some of the sori bear spores incapable of infection while others bear spores capable of infection. It is proposed to use the term *pycnium* for the sori with inefficient spores. Neither the term nor the manner of defining it raises the question whether or not these are vestigial sex organs. On that point each worker may entertain his own views. The important point in this connection is that these inefficient fruiting structures are in all structural essentials *sori*, whatever may be their origin or function.

The fact that the pycnia may be present or absent in both macrocyclic and microcyclic rusts is so well known that further comment is unnecessary. The significance of their presence or absence is another question not necessarily to be discussed in this connection.

The fifth dictum states that there are two efficient spore-forms essential to a macrocyclic rust, the initial form and the final form. A third efficient but unessential form is the intermediate repeating stage, which is not always present. For the sori of the initial spore-stage, which vary in form in different rusts, it is proposed to use *aecium* as a general term. The structures included here are often called by various special names according to form, being derived from form-genus names. When there is a cupulate peridium with catenulate spores, *aecidium* is used; if the peridium is blister-like, the structure is a *peridermium;* if there is no peridium and the spores are catenulate, *caeoma* is the term; if there is no peridium and the spores are stylosporic, it has been customary to call the structure a *primary uredo.* The use of " primary uredo " in this connection is unfortunate since there are cases where the first sori produced of the genuine repeating stage are different in appearance from the later sori and the term *primary uredo,* if useful at all, would be applicable here. It seems most logical and serviceable to have a common term for the sori of these several initial stages which have been passing under the various terms, aecidium, peridermium, caeoma, roestelia, and "primary uredo." These and other old terms may still be useful although often confusing or inadequate. They are largely founded on gross structural characters which in themselves are insufficient to delimit any sorus. For example, an ordinary description of a caeoma structure might apply in one rust to the initial spore-stage while in another it might apply to the repeating stage. To say *caeomoid aecium* would carry with it a definiteness of nature which is desirable in analyzing these complicated species. The intermediate repeating stage has been called the uredo-stage and there is less confusion regarding the situation here than in the initial stage. The chief objection to *uredo* is that the same word is doing duty as a form genus and that it does not lend itself to the making of a uniform set of derivatives as does the term *uredinium.* For the sorus of the final spore-stage which ends the life cycle in all macrocyclic rusts, although only produced at long intervals in some species, the term *telium* seems most acceptable. It refers to a single sorus which in the older terminology is called a teleutosorus or teleutospore-sorus. Speaking collectively, *telial* stage replaces the awkward term teleutospore-stage.

As pointed out in the Botanical Gazette paper twenty years ago it is necessary to say in the older terminology that aecidia appeared, after a time they were followed by the uredo, and finally the teleutospore stage was developed. For the three stages representing analogous spore-structures three different types of terms are required. In the newer terminology it is possible to say that aecia appeared, and that they were followed in turn by uredinia and telia. These terms can be used in the singular or plural, in the adjective form, or in combination with spore. It can be justly claimed that they do away with ambiguity and permit a conciseness and uniformity of statement not possible with the older terms.

Turning now to the microcyclic rusts it is pointed out in the fifth dictum that they have but one type of sori with efficient spores, which in some rusts resemble the macrocyclic aecia, and in others the macrocyclic telia, and that they may be called respectively aecia and telia. This is interpreted that the sori and spores in a species of *Endophyllum* may be called aecia and aeciospores, and in a species such as *Puccinia Malvacearum* they may be called telia and teliospores.

During the summer of 1925 the authors had the good fortune of discussing some of the problems here presented with numerous mycologists at home and abroad. This statement is made not to intimate that these conclusions represent in any sense a consensus of opinion but to acknowledge that this presentation has been influenced by the ideas and suggestions gained from the conferences with our colleagues. We realize, as has been pointed out to us, that scientific terms like ordinary language expressions are not dictated from ideals but gain standing by usage. It has seemed to us worth while, nevertheless, to make a contribution which may have its effect on usage.

NOTES AND BRIEF ARTICLES

Professor T. H. Macbride has been spending the winter in Washington and Southern California, his time being devoted to a continuation of his studies on the North American slime-moulds.

Professor C. R. Orton of Pennsylvania State College delivered a lecture at the New York Botanical Garden on November 14, the subject being "Seeds as Carriers of Disease." Dr. Orton is spending the present year at the Boyce Thompson Institute prosecuting research work along this line.

Professor H. H. Whetzel, accompanied by the Editor of this periodical, spent one month during the winter in Bermuda in continuation of the study of the fungi of those islands. A more extended account of this expedition will appear in a later issue of MYCOLOGIA.

Early in November Dr. W. A. Murrill left his home in Virginia for Green Cove Springs, Florida, where he planned to spend several weeks collecting fungi and enjoying the mild climate of the south.

MYCOPHAGY

The title of this brief note is applied to one of the most popular phases of mycology, *i.e.*, the eating of fungi. There is probably no question with which the mycologist is more frequently confronted than "How do you tell a mushroom from a toadstool?" The interrogator invariably has in mind some "fool proof" rule by which an edible fungus may be distinguished from a poisonous one. So far as we are aware there is no such infallible test, although many an amateur will assure you that he has one.

The only sure test is to try and this may have disastrous results. The best procedure is to gradually become acquainted with the edible forms so that one can recognize them as he would his friends, by their features. This may be a slow process but it is the safest rule to follow. It may be best at first to confine one's experiments to a few well characterized species. When a new one is encountered that looks promising, proceed cautiously until sure of one's ground.

In order to assist the beginner Dr. W. A. Murrill, formerly editor of MYCOLOGIA, has prepared a colored chart of the most common edible and poisonous species with a descriptive handbook to accompany it. These may be purchased through this institution or directly from the agents.[1]

Under the heading of "Mycophagy" we will be glad to publish in MYCOLOGIA original notes or observations on the merits of the various species of fungi, as articles of diet. Personal experiences whether favorable or otherwise are acceptable and would doubtless be of value to others who are interested in this phase of mycology.

F. J. SEAVER.

FUNGOUS DISEASES OF FRUIT TREES AND THEIR REMEDIAL TREATMENT, BY G. H. CUNNINGHAM[2]

This is an excellently printed book of 382 pages. It is dedicated to the veteran Australian plant pathologist, Daniel McAlpine. In his preface the writer states that this work is based upon five years of study of the fungous diseases attacking commercial orchards in New Zealand. Considering the relatively short period that the author has thus devoted to these diseases his work appears to be exceptionally accurate and complete. The material is well organized and fully illustrated with drawings and fine photographs. The book is divided into two sections. First a general section dealing with such matters as the geography and climate of New Zealand, the elementary botany of fruit trees, wounds and wound treatment, the structure and physiology of fungous and bacterial pathogenes and some four general chapters on control method for diseases of fruits.

The second section is taken up with a detailed consideration of the most important fruit diseases occurring in the islands.

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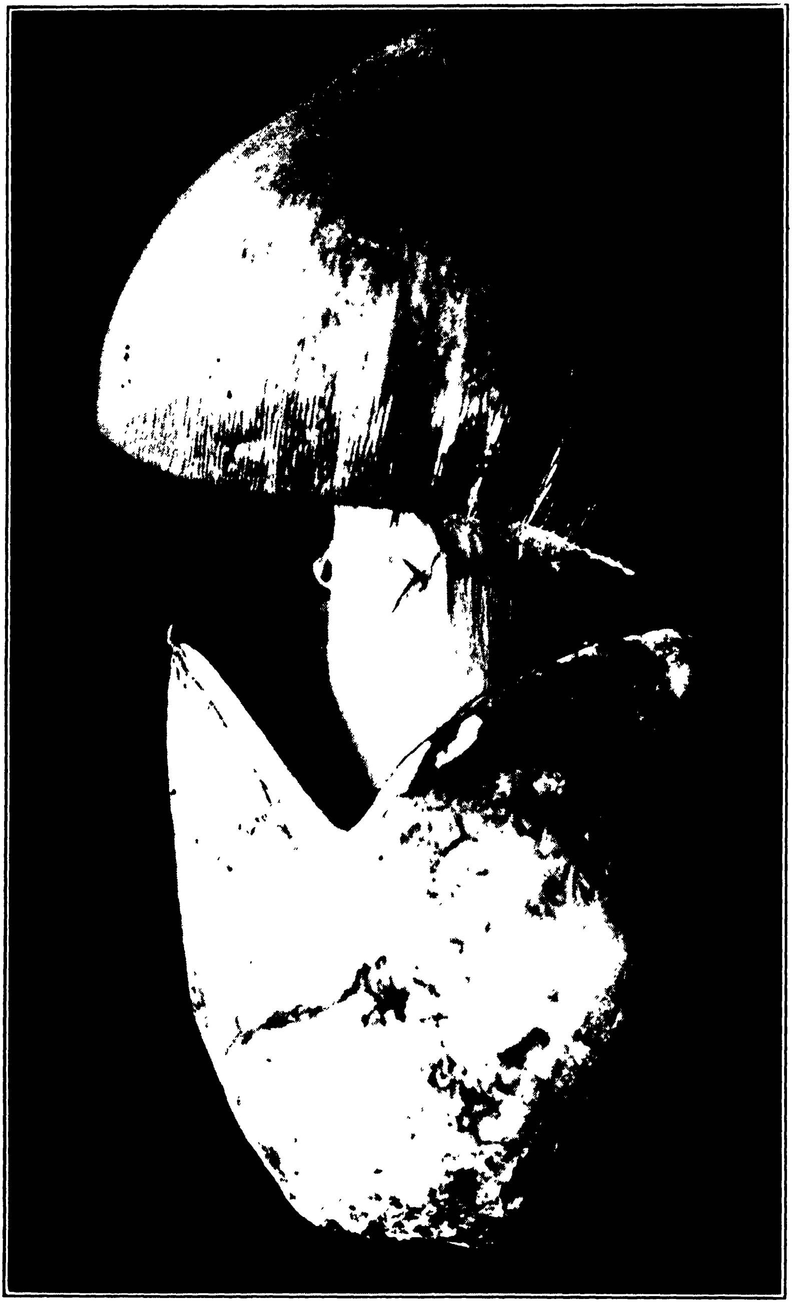
[1] Kny-Scheerer Corporation, 119 Seventh Avenue, N. Y. City.

[2] Published under the authority of the New Zealand Fruit Growers Federation. Brett Printing and Publishing Company, Auckland, New Zealand, 1925.

There are some 17 chapters in this part. These are divided into three groups: the first on diseases of pome fruits; the second on diseases of stone fruits; and the third on diseases of citrus fruits. Each group of chapters is introduced by an artificial key, for determining these diseases, based upon symptoms. Thirty different diseases of pome fruits are treated in considerable details. For stone fruits twenty-three diseases are so treated and of citrus fruits seventeen diseases receive special treatment. Of special interest to American pathologists is his discussion of the fire blight which has recently appeared in New Zealand and has proven very destructive. The arrangement of the data with respect to each disease is, in general, first a historical review, particularly with respect to the disease in New Zealand. Then follows a brief description of the symptoms, in most cases illustrated with excellent photographs. A short paragraph is devoted to the economic importance of the disease and the life history of the pathogene. Control is dealt with in a concise but adequate manner. For the more important diseases a short summary concludes the discussion. There is an excellent bibliography with an index of suscepts and pathogenes. It is a book which every worker on the diseases of fruits should have at hand. Since a large number of these diseases in New Zealand occur in this country the book will be found especially useful for American workers.

H. H. WHETZEL



AMANITA ARKANSANA

MYCOLOGIA

VOL. XVIII MAY–JUNE, 1926 NO. 3

A NEW AMANITA FROM ARKANSAS

H. R. ROSEN

(WITH PLATES 9–11)

Amanita arkansana sp. nov.

Pileus 10–15 cm. broad, occasionally considerably larger, at first conical or hemispherical, later convex to expanded, very slight if any viscidity, orange-buff to baryta-yellow (Ridgway), usually lemon-yellow at the margin and deeper yellow above, never red, or orange-red, older or dried specimens are mostly tan colored with faint tinges of yellow, glabrous, rarely with 1 or more large whitish patches, remnants of the universal veil, margin conspicuously striate, the striations extending 2–4 cm. from margin. *Gills* adnexed by a line, the line usually extending 1 or 2 cm. down the stem, yellow at first, particularly on the edges and near the flesh, gradually fading to creamy white or whitish, 1–1.5 cm. broad at the widest point, this being somewhat closer to the margin than to the apex. *Stem* 10–15 cm. long, 1.5–3.0 cm. thick, usually stout, slightly thicker in the region of the volva, glabrous below and usually with irregular patches or fibrils on the upper half, stuffed with soft, cottony material at first, then hollow, yellow, the fibrils becoming darker yellow when handled. *Annulus* superior, attached about 1 cm. below the top of the stem, yellow, large, up to 4 cm. long, pendant, membranous. *Volva* white, firm, very thick below, often as much as 1 cm., thinner toward the entire margin, consisting usually of the whole of the universal veil, quite fleshy even at the margin (see PLATE 9), forming a fair sized cup, the ample free margin of which is always free from the stem when young and usually so at maturity, mostly 3–6 cm. long (1 specimen found with a volva 11 cm. long, PLATE 9). *Spores* broadly ellipsoid or ovoid,

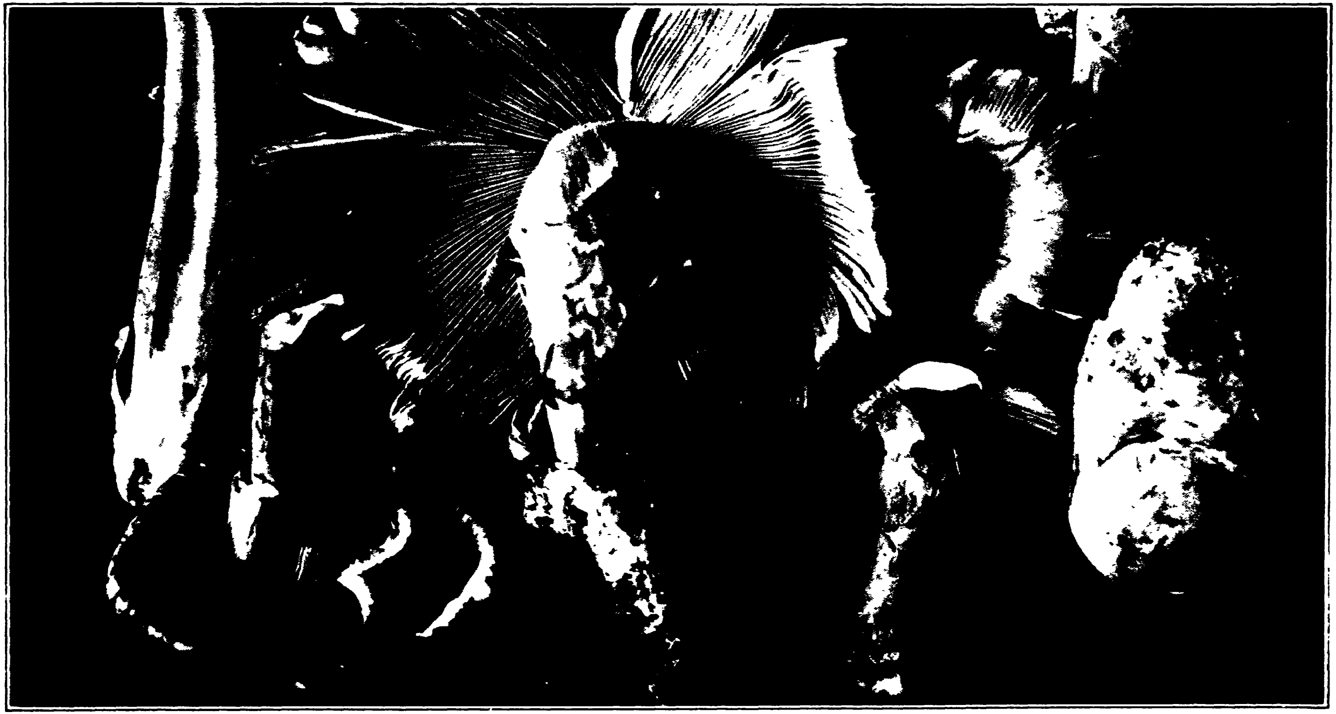
[MYCOLOGIA for March–April (**18**: 51–96) was issued March 3, 1926]

frequently with an apiculus irregularly disposed, often with a single large guttula, or granular, 7.5–10 × 7–8 μ exclusive of apiculus. Odor mild, somewhat sweetish.

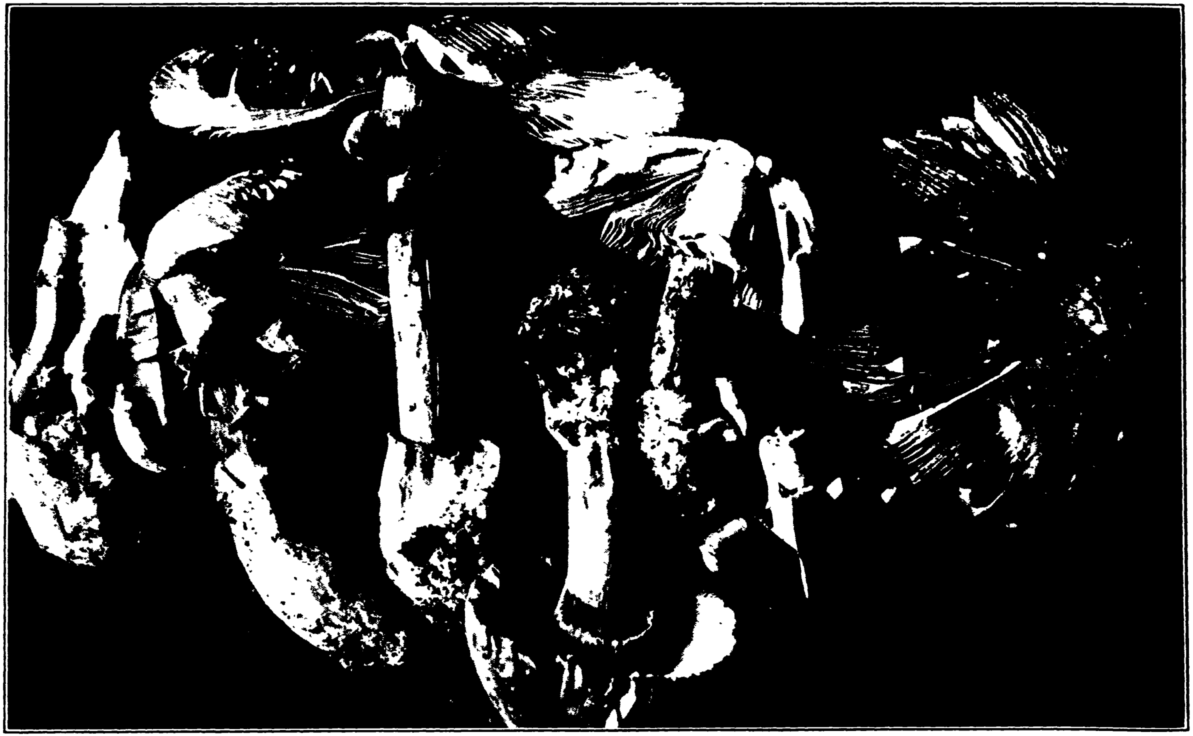
Solitary or scattered gregarious, occasionally in troops. On the ground in frondose woods. Very abundant in region east of Fayetteville, Arkansas, during a rainy spell in first part of October, 1925.

This large, beautiful mushroom was first called to my attention by Dr. G. E. Hastings of the English Department, University of Arkansas. He brought in the monster shown in PLATE 9. As the specimen when first seen was not fully developed, identification was rather difficult. Even after a period of 4 days, during which the pileus had considerably expanded, identity of the fungus remained uncertain. Not a sign of a gill was to be seen, the under surface of the pileus being covered with a heavy coating of tissue, the partial veil. This, in addition to sheathing the gills at the margin of the pileus, extended upward along the gill surface, clothed with irregular extensions, homologous to similar particles on the upper part of the stem. Finally, this whole inner or partial veil ruptured, becoming a large, pendant annulus. I at first considered this as an abnormally large *Amanita Caesaria*, which was off color. It had the yellow gills, the striate margin of the pileus, and other features connected with the emperor mushroom.

The discovery by the writer of an amazingly large number of the same species several days after the finding of the first specimen finally convinced me that this was not *A. Caesaria*. On this trip, October 13, I also collected large numbers of the true emperor mushroom, although this is the first time I have seen it in Arkansas. It was noted that wherever the yellow colored form appeared all the pilei possessed the same color, and wherever a red one was found, if any others appeared they likewise were red. Several times good-sized troops, consisting of 6 to 12 carpophores, of both kinds, were found in close proximity, the troop of each kind always showing but one color with no gradations. Occasionally, when examining a group, I found hidden below the fallen leaves young forms which were just beginning to break through the universal veil and these also showed the brilliant red or the bright yellow, according to the color of the



AMANITA ARKANSANA



Amanita Caesaria

adjoining specimens. Obviously this difference in color is not due to difference in habitat or in stage of development.

A careful study of the 2 forms revealed other differences. The volva is larger and notably more fleshy in the yellow form (see PLATE 9). The gills while similar in young specimens are whiter, some being snow white, in older specimens of the yellow form. The annulus is more ample and not as delicate (see PLATES 10 AND 11). The spores are somewhat smaller, those of the yellow form average 8.5 × 7 μ, while those of *A. Caesaria* gathered at the same time and of comparable development average 10.5 × 7 μ. (Coker's measurements of *A. Caesaria*, Jour. Elisha Mitchell Sci. Soc. **33**: 19. 1917, are somewhat large for average spores. My figures agree well with Murrill's N. Am. Fl. **10**: 69. 1914.)

While these were gathered in October, there is a strong possibility that it is ordinarily a summer mushroom. The reason why I suspect this is that I gathered at the same time *A. Caesaria*, which is usually considered a summer form, and I also found in considerable abundance *A. phalloides* and *A. rubescens*, both of which I usually find in early summer in this region. The very dry summer of 1925 evidently had something to do with this.

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EXPLANATION OF PLATES

PLATE 9. An abnormally large *Amanita arkansana*, with a volva measuring 11 cm. in length, and the whole carpophore attaining a height of about 20 cm. Reduced to about ¾ natural size.

PLATE 10. *A. arkansana* showing the large pendant annulus on several specimens. For details of volva see FIG. 1. Reduced to about ½ natural size.

PLATE 11. *A. Caesaria* showing size and nature of volva and annulus. Reduced to about ½ natural size.

THE DEVELOPMENT OF THE PERITHECIA IN THE MICROTHYRIACEAE AND A COMPARISON WITH MELIOLA

Ruth Winifred Ryan

(With Plates 12–15)

In recent years many advances have been made in the taxonomy of the fungi. Perhaps in no one group has there occurred as many changes as in the Microthyriaceae. Under the leadership of von Höhnel the entire bases of the family became subject to critical investigation followed by a complete revolution of the classification.

The family was placed among the Dothideales by Saccardo (**9**) in 1883. Since then it has been described as belonging to the Perisporiales. Atkinson (**2**), however, considered that they have little in common with this order. He believed that the Microthyriaceae represent reduced forms derived on the one hand from the Phacidiales and, perhaps, on the other from the Sphaeriales. He did not say definitely, though, where they do belong. Theissen and Sydow (**15**) placed the family in a new order, the Hemispheriales, which they created for genera having a superficial, halbert- to shield-shaped perithecium. Miss Doidge (**4**) accepts this classification in her systematic work. According to Arnaud (**1**) the family belongs to the Pyrenomycetes, because, he says, the asci are localized in particular zones formed by the gelatinization of the sterile cells of the cavity. The Microthyriaceae would thereby be near neighbors of the Myriangiaceae. In my taxonomic study of the Microthyriaceae of Porto Rico (**8**) and Hawaii (**10**), I used the classification given by Theissen and Sydow. The Microthyriaceae seem to me more closely related to the Hemisphaeriales than to the other groups with which the family had formerly been placed.

The first description for the family is given by Saccardo (**9**). Translated, it reads "simple perithecia superficial, black, membranous to carbonaceous, dimidiate, flattened; context nearly always radiate." This description is accurate. The characters are firmly established and easily recognizable.

The various genera of the family can be placed in two groups according to Theissen (12) and Arnaud (1), those having a free mycelium and those in which it is lacking. The present paper deals with the development of the perithecia in the eleven genera that have a superficial mycelium. The material for study was obtained from the herbarium of the University of Illinois from collections made by Dr. F. L. Stevens in Porto Rico, Hawaii, and British Guiana.

The mycelium in all the eleven genera plays an essential role in the development of the perithecium. Its characteristics are well determined and hereditarily fixed. It is brown, cylindrical, septate, tough and may or may not bear hyphopodia or nodulate cells. These last two structures also play a part in the formation of the perithecium.

Formerly it was thought that the hyphopodia when they occurred on the mycelium of fungi might be sexual organs. This was at first supposed to be the case in *Meliola*. Ward (17) in studying this genus suggested that the hyphopodia were such. More recently Thaxter (11) has compared them to the antheridia of the Laboulbeniales. Arnaud (1) is of the opinion that they do not function as sexual organs and that they are merely the rudiments of the perithecia and absorptive organs. Investigations by Maire (6) show that the hyphopodia in *Meliola* function as organs of absorption and attachment. Cytological studies by Arnaud (1) seem to indicate that the same relation to the host tissue exists in the Microthyriaceae.

Arnaud includes *Meliola* in his study of the Asterinées (1). To me they seem fundamentally different as portrayed in their development. For this reason I have placed them in the Perisporiaceae as does Beeli (3).

The hyphopodia in *Meliola* are two-celled, while they are either one- or two-celled in the Microthyriaceae. In the Microthyriaceae and in *Meliola* they may be opposite or alternate, the majority being the latter. Often one finds several hyphopodia arranged on one side of the mycelium, while further on in the same filament they will be either opposite or alternate. The characteristic arrangement of the structure may be used as an aid in classification.

The formation of the perithecium in the majority of ascomycetes results from the activity of sexual organs, which have the power of conjugation. This fusion then is the point of development of the perithecium. In *Meliola* (17) the hyphopodia substitute for these organs. Those that give rise to perithecia have a reflexed swollen end and produce the fruiting structures through proliferation. In the Microthyriaceae the hyphopodia though not sexual organs give rise to the perithecia in certain cases. This family advances further, for here the perithecia may arise independently of the hyphopodia, that is, from the mycelial cells themselves. This method of origin seems to be by far the most common.

A search through mycological literature revealed only a few articles which bear in any way on the development of these fungi. Gaillard (5) studied a few species of *Asterina*. He says that the summit of the hyphopodium turns toward the leaf. This small cell divides, at the same time becoming clearer. The primitive membrane becomes thinner, budding in places and appearing as a small lenticular body closely applied against the leaf. Its surface is covered by deep lobes, which in growing seem to radiate around a point, which is the place of insertion on the mycelium of the primitive hyphopodium. In the majority of cases the hyphopodia do not participate alone in the division, but the portion of the mycelium where it is inserted also takes an active part. Thus he indicates one method of development characteristic of the genus and of the family as a whole.

Raciborski (7) refers to the subject only in passing, saying that the perithecia are borne laterally on the hyphae as in *Balladyna*, *Aldona*, *Dimerosporium*, or *Meliola*, and that they grow conical and broaden against the leaf. Miss Doidge (4) briefly gives two methods; from a medial cell of a hypha and from the terminal cell of a short lateral branch. She does not go into any detail.

Theissen (13) says that divisions in the hyphae give rise to irregular cells by the insertion of several cross walls. The perithecium arises on the lower surface of the hyphae. A small knot of cells is formed and is the base of the perithecium, which continues to grow radially and centrifugally to a disk-shaped structure. The radial walls remain locked together. New radial walls become inserted so that the disk shape is maintained.

Arnaud (1) thinks that the fertile stroma arises by the proliferation of a cell or a small number of cells which put out filaments extending radially on the cuticle of the host, and which fork enough to form a continuous bed. These proliferations constitute a regular radiate disk. As this plate becomes thickened on its inferior face, the superior face conserves on all its extent the radiate structure.

Von Höhnel (16) states that the shield-shaped structure is merely a protective cover for the independent perithecia which develop inversely beneath it.

Raciborski (7) was the first, however, to state that the perithecia were inverse. Theissen, Miss Doidge, Arnaud, and von Höhnel have accepted his statement as being correct. By inverse, one understands the perithecia to be fastened on the under side of the hypha. The oldest or basal part therefore is above the newest or marginal part of the fruiting body. Von Höhnel also pointed out that the asci arise from the part of the perithecium pressed against the leaf, or from the youngest and the top part of the structure. The asci are, therefore, inverted in the perithecium, but are borne upright on the surface of the leaf. This meaning of the term inverse has been used in this discussion.

As I have stated previously, in *Meliola* the fructifications are always derived from hyphopodia, while in the Microthyriaceae in certain instances the perithecia are formed from the hyphopodium; in other instances from the cells of the mycelium. This latter method is characteristic of species which have a non-hyphopodiate mycelium, but which form as many fructifications as the others.

The origin directly from the mycelium predominates throughout all the genera of the family. Out of the ninety-four species studied eighty-four show this method of development.

Portions of the mycelium were fixed in cellodin, mounted and studied under oil immersion. The mycelium sometimes was slightly swollen in regions where a perithecium was developing.

At other times it remained normal. In either case, however, cross septa appeared, giving rise to one or more small cells. Rarely does the number exceed five. These cells are nearly square in shape, otherwise showing no differentiation from the rest of the mycelium. They all seem to function alike in the formation of the perithecium (Plate 12, Fig. 8).

They give rise to bud-like growths (Plate 12, Fig. 4). These budded cells are irregular in outline, often distinctly lobed on their free margins. They may occur on both lateral margins of the mycelium. The budded cells likewise divide increasing the number of cells centrifugally. These cells are united to one another so that a disk-like structure is produced (Plate 12, Fig. 6). Further cells are added to the structure until finally the maximum growth of the perithecium is reached. The walls of these cells are thick and dark. There may be more than one layer of them. Cross sections of the perithecium generally show at least two.

The second method of origin is from hyphopodia which are one- to two-celled structures located on the lateral margins of the mycelium. If the hyphopodium has only one cell, this cell buds several times (Plate 14, Fig. 43). The budded cells in turn proliferate, the new cells being laid down in rows (Plate 14, Fig. 43). This process continues until the maximum growth has been reached. The radiate structure can be observed after several rows of cells have been formed.

If the hyphopodium is a two-celled structure, the terminal cell only participates in the formation of the perithecium. This cell buds in the same manner as does the one-celled hyphopodium. In both kinds of hyphopodial development, as well as in the development from the mycelium, the perithecium produced is always inverse at maturity.

A third type of development is from short lateral branches. This method is less common; only six species of all those investigated show this method of origin. The lateral branch of the mycelium, consisting of one to three cells, is ordinarily borne at an acute angle (Plate 12, Fig. 14). The terminal cell in all cases is the one that functions in the production of the fruiting structure. This cell buds in a manner like that of the terminal cell of the hyphopodium. *Asterina Gouldiae* is a typical example of this mode.

Only two species having nodulate cells in the mycelium were studied. These were *Asterina inaequalis* var. *nodulosa* (PLATE 12, FIG. 13) and *Asterina Schroeteri* (PLATE 13, FIG. 15). In both these forms the perithecium did not develop from the nodulate cell, but from an undifferentiated cell of the mycelium. The manner of growth was like that already described in the first method.

Gaillard (**13**) gives illustrations of *Asterina stricta* which has nodulate cells that develop into the perithecia. This would indicate that there were two ways of producing a perithecium in the species which possess this kind of a mycelium. A further study of other species with a like mycelium would be interesting and would enable one to form a more accurate idea of the true method of origin in these species.

In all the genera after the disk has reached its specific extension the radial growth is halted. The central part has meanwhile swollen from the middle of the perithecial hollow, while the peripheral growth remains close to the leaf. The result is a concave perithecium, which is only half a one in reality and is developed below the mycelium.

The preceding description of the development of the perithecium can be applied to all the genera, for even those having oblong perithecia at maturity are at first circular. The elongate character is due to the more rapid growth of the perithecium on two opposite points on the disk. Frequently a three-angled perithecium is observed. This seems to be the result of growth at three points on the disk instead of at two.

Contrasted to these various methods of origin, the perithecia in *Meliola* exhibit an unexpected constancy. In the forty species studied, all showed origin from the hyphopodia. Furthermore, the method of development observed agreed in detail with that reported by Marshall Ward (**17**). A brief summary is given here.

The simple pyriform body, the hyphopodium, after becoming swollen, suffers division into two portions or cells by a septum, usually vertically to the plane of the mycelium and leaf, and passing diagonally across the cavity with a slight curve so as to abut on the outer walls at right angles, or nearly so. The original unicellular protuberance becomes in this manner divided into two more or less unequal cells which have different destinies. The more apical cell divides more slowly and forms a mass of cells, the central ascogenous tissue, of the young perithecium. The outer cell divides much more rapidly, producing a layer of cells which gradually develops the thin-walled cells of the outer portion of the perithecium. These thin-walled cells make the ascogonium. In later stages, according to Ward, certain of the constituents are seen to form asci and spores, while others deliquesce and serve as nutritive material. The outer walls, as in the Microthyriaceae, become thick, hard, and dark colored. The perithecium in *Meliola* is always produced from the upper side of the mycelium so that it is never inverse (PLATE 15, FIG. 1) and is always spherical or approximately so.

While this method of development holds for the majority of the species of *Meliola*, there are six species which show more distinct relationship to the Microthyriaceae. Beeli in his monograph of the genus *Meliola* (**3**) makes a division on the character of the radiate and pseudoparenchymatous tissue, placing the six species referred to in one group. He seems to have either overlooked the previous work of Theissen on *Meliola* (**14**) or to have rejected it.

Theissen studied specimens of *Meliola asterinoides* and created for it a new genus, *Amazonia*, which he placed in the Microthyriaceae because of its radiate inverse perithecia. In studying material labeled *Meliola Psychotriae*, one of the other five species in this group, I have found that the development of the fruiting body approximates the development of the perithecium in the Microthyriaceae. The origin is from the hyphopodium, which proliferates in the manner already described for the hyphopodial origin in the Microthyriaceae. There is no definitely arranged method of division, as in *Meliola*, for the cells formed may or may not be of the same size. Furthermore, there may be more than two cells produced. In any circumstance the cells do not seem to form definite regions of the perithecium as in *Meliola* (PLATE 12, FIG. 7). At maturity or during the latter part of growth, the fruiting structure is inverse and radiate, thus differing in two essential characters from *Meliola*. For these reasons I have followed Theissen's classification and placed the fungus in the genus *Amazonia*.

Meliola Laguncularíae, like the foregoing species, is also inverse radiate (PLATE 15, FIG. 15). The method of development of the perithecium is like that described above. Therefore, this species should also be placed in the genus *Amazonia* as **Amazonia Laguncularíae** comb. nov.

I did not study the other species listed by Beeli in his first division, but in all probability they will show the same characters as the two foregoing species and, therefore, will be placed in the same genus.

In some of the Microthyriaceae an ostiole-like opening appears. This is not an "ostiole" in the true sense of the word. It appears at maturity and is due to the gelatinization or cracking of the central cells around the point of insertion on the mycelium or hyphopodium. The region where this occurs is the oldest and basal portion of the perithecium, and not the youngest and top part as one would ordinarily expect. There is evidently no precise method of development for the "ostiole." When the perithecium is round the opening may be circular with ragged edges, due to the loss of several of the central cells (PLATE 14, FIG. 40), or it may be stellar, due to the severance of some of the cells along the lateral walls (PLATE 14, FIG. 33). Frequently these fissures extend almost to the margin of the perithecium. Or the entire central region of the perithecium may become gelatinous and disappear, leaving the asci fully exposed.

In genera where the perithecia are oblong in shape, the "ostiole" follows the shape of the fruiting structure. It may remain narrow, so that it is thread-like in appearance, or it may become greatly widened, in which case the asci are exposed. In these oblong perithecia the lenticular "ostiole" may become stellar at its ends.

"Ostioles," however, do not occur in all the species before they reach maturity. Before the dispersal of the spores can take place though, the shield-like structure must be ruptured or become disintegrated. In *Meliola*, the rupturing of the perithecium occurs in the youngest and the top part of the perithecium. This is diametrically opposed to that of the Microthyriaceae. In *Amazonia Psychotriae* the "ostiole" is like that of the family to which it belongs.

The typical young fruiting body in the Microthyriaceae is always light brown in color. The radiate cell structure is apparent. On maturity it often becomes a dark brown, darker than the mycelium. The margin, though, remains lighter in color and the radiate character persists. At times, though, the radiate structure is not apparent, until the material has been boiled in potassium hydroxide, or a young specimen has been observed. When the first cells of the perithecium are laid, they ordinarily are arranged in a row. The next cells also occur in a row, and it is not until then that the perithecium begins to look radiate. On maturity, too, this character may be nearly obscured. In some genera the central cells gelatinize, so that only the marginal cells remain intact. These, however, always show the character. Other genera have perithecia which become almost wholly carbonaceous. But in such cases the margin again gives the character.

SUMMARY

The Microthyriaceae show four characteristic ways of developing the perithecia. The methods are: from a cell of the mycelium; from hyphopodia; from the short lateral branch; from a nodulate cell. The most common way is from a cell of the mycelium.

The perithecia are flattened.

In early stages the fruiting structure is radiate. This character later may be lost due to the perithecia losing its top through becoming gelatinous or carbonaceous. However, at all times the edge of the structure will show the character.

The perithecia are all inverse, that is, they are borne on the lower surface of the mycelium.

At maturity the perithecia break open, thus permitting the spores to escape. Often, however, an "ostiolar" opening appears at the base of the perithecium. This may be round, stellar, or linear in shape.

In *Meliola* the perithecia always arise from hyphopodia.

The perithecia are more or less round, never flattened. They never show the radiate character at maturity, although a few species may do so when very young.

The perithecia are never inverse, but are always borne on the upper surface of the hyphopodium.

Meliola Psychotriae is radiate and inverse as is also *Meliola Laguncularia;* they, therefore, belong to the genus *Amazonia.* An undetermined perisporiaceous form also showed the radiate perithecia and so rightfully belongs to Microthyriaceae.

The following table lists the genera of the Microthyriaceae examined in this study. Hypho. stands for hyphopodia; myc., mycelium; lat. br., lateral branch; nod., nodulate cell.

Genus	Method of Development				Ostiole		
	Myc.	Hypho.	Lat. Br.	Nod.	Linear	Stellar	Round
Asterina	35	3	2	2	7	7	11
Asterinella	6	1	1			4	7
Amazonia		1	1				1
Aulographum	1				1	1	
Calothyriopeltis	3					1	
Echidnodes	3				3		
Echidnodella	5				5		
Englerulaster	2		1				3
Lembosia	10				10		
Morenoella	16				16		
Questieria	1		1				3

	Method of Development				Perithecia			
			Hypho.		Inv.	Not Inv.	Rad.	Not Rad.
Meliola			40		2	38	4	36

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EXPLANATION OF PLATES

All figures were drawn from material mounted in celloidin and drawn with the aid of a Spencer camera lucida, and were reduced one half in reproduction. PLATES 12 to 15 show stages in the development of the perithecia in the various species studied.

PLATE 12

Fig. 1, *Morenoella decalvans* var. *Stigmatophylli;* 2, *M. Calami;* 3, *Asterinella multilobata;* 4, *A. Hippeastri;* 5, *A. Ixorae;* 6, *A. Phoradendri;* 7, *Amazonia Psychotriae;* 8, *Calothyriopeltis Scaevolae;* 9, *Lembosia Sclerolobii;* 10, *L. Coccolobae;* 11, *L. ananensis;* 12, *L. portoricensis;* 13, *Asterina inaequalis* var. *nodulosa;* 14, *A. Gouldiae.*

PLATE 13

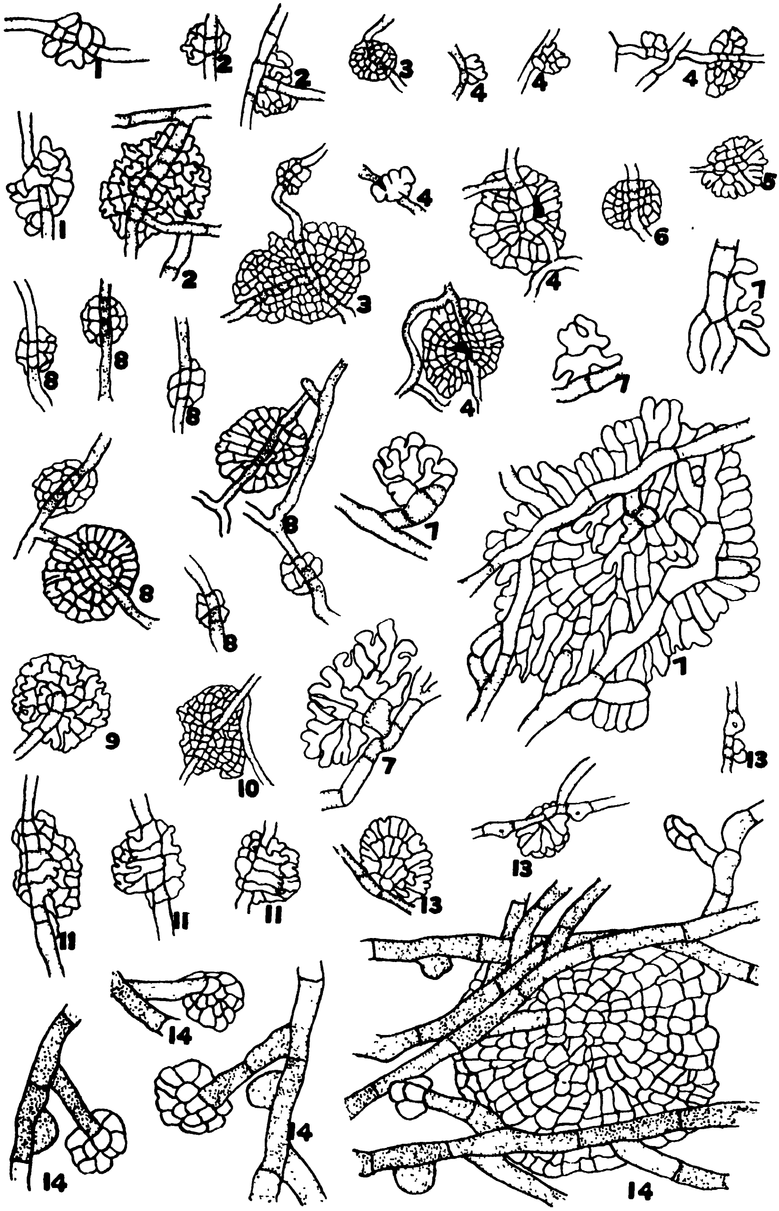
Fig. 15, *Asterina Schroeteri;* 16, *A. acanthopoda;* 17, *Morenoella decalvans* var. *Rondeletiae;* 18, *M. Pothoidei* var. *Laevigatae;* 19, *M. Psychotriae;* 20, *M. decalvans* var. *Laugeriae;* 21, *M. Laugeriae;* 22, *M. miconicola;* 23, *M. impetiolaris;* 24, *M. Miconiae;* 25, *M. Melastomacearum;* 26, *Asterina diplocarpa;* 27, *A. Arnaudia;* 28, *A. Chrysophylli;* 29, *A. dilabens;* 30, *A. Rickii;* 31, *A. Clermontiae;* 32, *A. Lobeliae;* 35, *A. dubii.*

PLATE 14

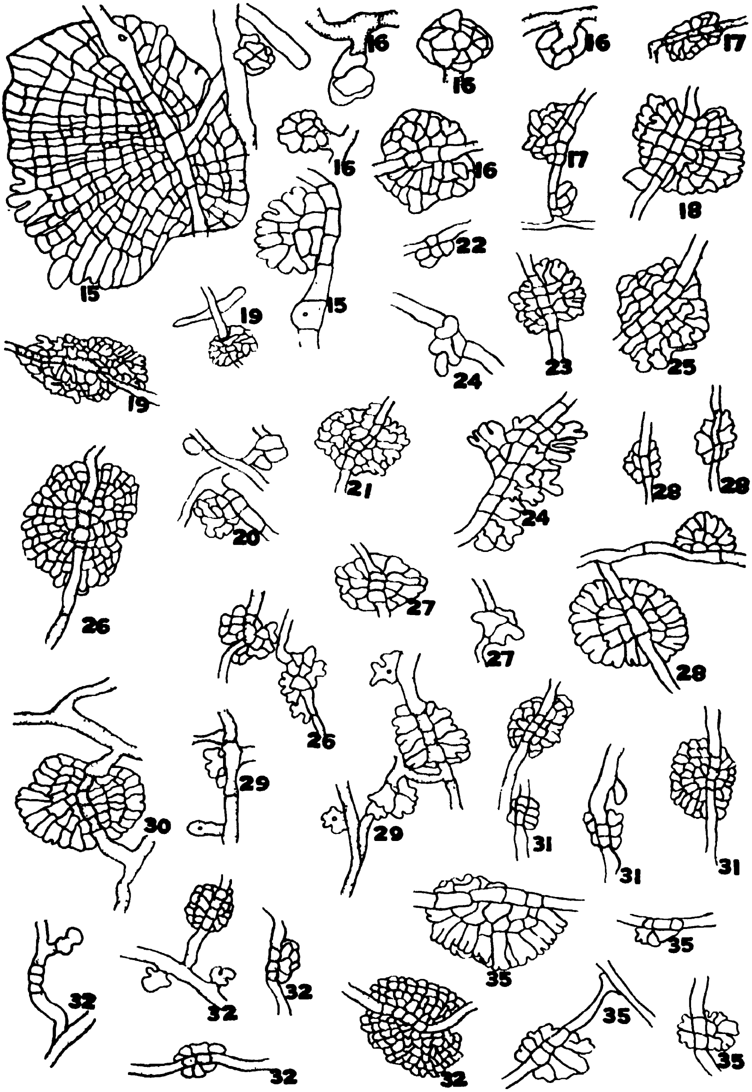
Fig. 33, *Asterina Ildefonsiae;* 34, *A. Fawcetti;* 36, *A. Hippocrateae;* 37, *A. correacola;* 38, *A. chrysophylliella;* 39, *A. kauaiensis;* 40, *Englerulaster orbicularis;* 41, *E. Papawiae;* 42, *Aulographum culmigenum;* 43, Unidentified Perisporiaceae.

PLATE 15

Fig. 1, *Meliola irregularis;* 2, *M. Lyoni;* 3, *M. Kaduae;* 4, *M. Koae;* 5, *M. maricaensis;* 6, *M. bidentata;* 7, *M. longipoda;* 8, *M. brasiliensis;* 9, *M. Dieffenbachiae;* 10, *M. Calophylli;* 11, *M. Juddiana;* 12, *M. hyptidicola;* 13, *M. Cyperi;* 14, *M. Kaduae;* 15, *M. Laguncularlae;* 16, *M. cyclopoda;* 17, *M. Marantae;* 18, *M. toruloidea;* 19, *M. brasiliensis.*



DEVELOPMENT OF PERITHECIA



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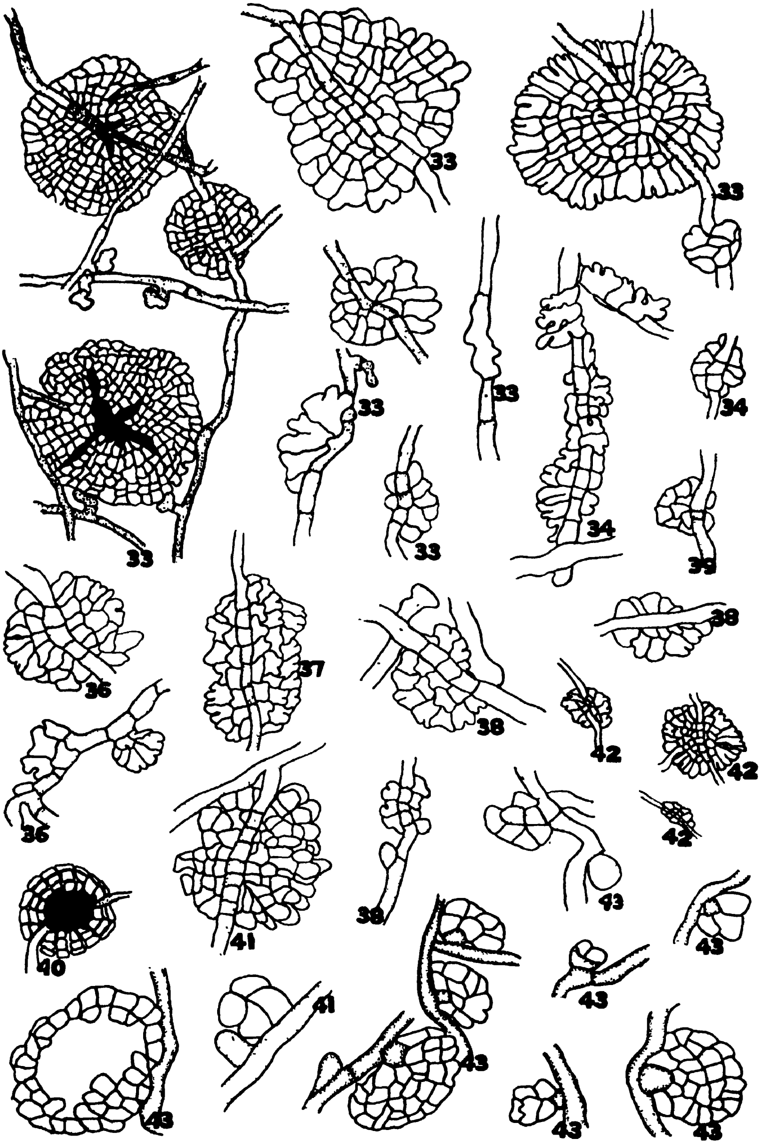

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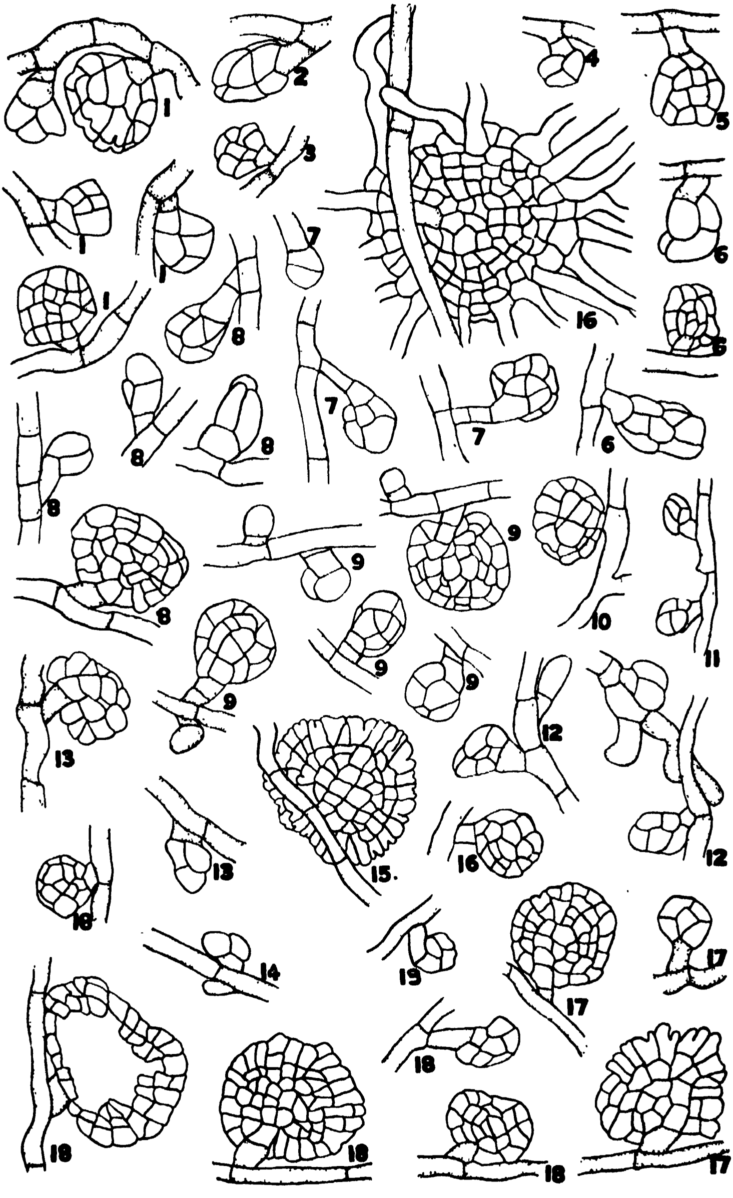

DEVELOPMENT OF PERITHECIA

STRATIFIED SPOROPHORES OF POLYPORUS GILVUS

Ray R. Hirt

The generally accepted basis for the separation of the genus *Fomes* from *Polyporus* among the Polyporaceae is its perennial growth, whereby a new layer of tubes is added to the sporophore from year to year, since the mycelium of the context and tube layer remains alive through the year. In his description of *Polyporus gilvus* (Schw.) Fries, Dr. L. O. Overholts reports that "the plants are annual or reviving for two or three years" (**1**), again, that "the plants are sometimes perennial" (**2**). In my present study of the biology of *Polyporus gilvus* I have collected a number of sporophores which showed a distinct stratification of the tube layers, indicating that the sporophore might at times be perennial.

During the summer of 1923 I made a study of some sporophores of *Polyporus gilvus* under natural growing conditions in the vicinity of Syracuse, and I was convinced that these stratifications of the tube layers did not indicate, for these sporophores at least, that they were perennial.

In my previous work I had found that if I brought blocks of wood infected with the above fungus into the laboratory during the late winter or early spring, and kept them under certain moisture and temperature conditions, normal sporophores would develop and produce spores for culture work which I was carrying on. With this point in mind, in February 1924 I brought into the laboratory a section from the trunk of a white oak infected with *Polyporus gilvus* and upon which were a few sporophores formed during the summer of 1923. Several of these sporophores I split in half to make sure that there was only one layer of tubes present but left them attached to the bark, the remaining sporophores I left intact. Tissue cultures from these were attempted but no mycelial growth was evident, although cultures from the decayed wood were easily obtained.

Within 40 hours after the wood was brought into the laboratory patches of mycelium were noticed around the base of a number of sporophores of 1923. Tissue cultures were again attempted from these sporophores but no growth was obtained, however cultures from the patches of mycelium developed rapidly. Thus it is readily seen that the hyphae of the context and the tube layers of the 1923 sporophores were dead and not capable of further growth. The fresh mycelium which appeared in the above mentioned patches was at first white and fluffy but soon became compact and brownish. Gradually they spread outward using the dead sporophores as a substratum upon which to grow, eventually entirely enveloping them, covering the upper surface with a new context and then upon the under surface developing a new layer of tubes from which spores were cast. At this point one of these compound sporophores was removed and tissue cultures again attempted from the enclosed sporophore as well as from the one enclosing it. From the former no growth was obtained, from the latter cultures were produced, again proving conclusively that the sporophore of the previous season had no active part in the production of the new sporophore.

The remaining sporophores about which new growth had appeared were allowed to develop until late May when they were removed and sectioned. Each one of these showed stratification similar to those which I had gathered in the field and at first thought to be perennial, but the former I knew to be annual since I had observed their entire development.

Late in the summer of 1924 sporophores of that summer's growth upon a certain white oak and white ash were marked for observation during the following spring and summer. Early in June 1925 new patches of mycelium were noticed at the bases of several of these fruiting bodies. They were closely watched and were found to develop similarly to the above, so that by late summer when the sporophores were gathered and sectioned, one not acquainted with their development might easily mistake them for perennials.

Whereas the above study indicates that the mycelium of *Polyporus gilvus* lives on in decayed wood from year to year and is therefore perennial, it also points out that the stratified sporophores of the fungus developed in this section of New York state are annuals, and I believe that this might prove to be true in other sections of the country if a careful study of the developing sporophores of *Polyporus gilvus* was made.

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THE SMUTS OF PORTO RICO AND THE VIRGIN ISLANDS

H. H. Whetzel and F. D. Kern

(With Plate 16)

As there appears to be no place in which our present knowledge of the smuts of Porto Rico and the Virgin Islands has been brought together the writers have undertaken a rather complete survey of the material available in the various herbaria in this country and of the scattered literature in which reference to them is to be found. We believe that the following annotated list is reasonably complete and that the bibliography appended hereto will give the reader the important sources of the records of smuts collected in these islands.

We wish to acknowledge in this connection the generous assistance which we have received from other workers in the preparation of the manuscript. Professor H. S. Jackson, plant pathologist of the Agricultural Experiment Station at Lafayette, Indiana, has critically examined the collections made by the writers and Mr. R. A. Toro during June and July 1924, and it is to him that we are especially indebted for the determination of the bulk of our material as well as for a critical reading of the manuscript. He has also prepared the description of the new species of *Tolyposporella* on *Sporobolus*. To Dr. G. P. Clinton of the Connecticut Agricultural Experiment Station, we are indebted for much valuable assistance in the clearing up of various points relating to certain species. He has also very kindly made a critical reading of the manuscript.

In addition to our own collections we have had before us Dr. G. P. Clinton's collection made in 1904, and already largely recorded in the North American Flora, volume 7; those of the Whetzel and Olive collection of 1916; the collections by Seaver and Chardon of 1923; the private collection of Mr. J. A. Stevenson of the Federal Horticultural Board, Washington, D. C., brought together during his long period of service in Porto Rico;

and the specimens of C. M. Tucker, pathologist of the Federal Experiment Station at Mayaguez, whose collection while small has contributed two new records to the smuts of this Island, namely *Ustilago Tritici* and *Sphacelotheca Sorghi.* Specimens of smuts from Porto Rico deposited in the New York Botanical Garden herbarium have also been examined. These contained duplicates of all of the specimens of smuts collected by Dr. F. L. Stevens, botanist and plant pathologist of the University of Illinois. To all who so generously assisted by making their material available to us we wish to express our keen appreciation and thanks as well as to all the others who in one way or another have assisted in making this list complete and accurate.

The list shows at a glance that the smut flora of Porto Rico and the Virgin Islands is very limited compared, for example, with the rust. But eight genera of smuts have thus far been found in these islands representing a total of 19 species certainly known to occur there. The genera *Doassansia* and *Urocystis* previously reported from Porto Rico appear to be based upon errors in determination.

Not only are the number of species of smuts occurring in these islands relatively few in number but they are for the most part rare or at least uncommon there, judging by the collections which have thus far been made. A few of them are common and widely distributed in Porto Rico, notably, *Ustilago affinis* on crab grass, *Sphacelotheca Panici-leucophei* on *Valota insularis*, *Cintractia axicola* occurring everywhere on *Fimbristylis diphylla*, *Cintractia leucoderma* on *Rynchospora corymbosa* and *Thecaphora pustulata* on *Bidens pilosa.* Among the forms herein reported the following appear to be peculiar to these islands on the hosts indicated: *Thecaphora pustulata* on *Bidens pilosa*, *Cintractia limitata* on *Cyperus ligularis*, *Cintractia minor* on *Cyperus sphacelatus*, *Entyloma Lobeliae* on *Lobelia Cliffortiana*, *Cintractia axicola* on *Fimbristylis ferruginea*, *Cintractia leucoderma* on *Rynchospora cyperioides.* In the case of the last two named species the hosts reported appear to be new for their respective species. A new species *Tolyposporella Sporoboli* Jackson on *Sporobolus indicus* is herein described.

All the specimens in the collection of Porto Rican fungi in the herbarium of Cornell University have been cited by number. Since these collections have been made at different times and numbered consecutively beginning with the Whetzel and Olive collection of 1916, the collectors' initials have been placed before the numbers cited: *W. & O.* refers to the specimens collected by Whetzel and Olive; *Char.* to collections by Chardon alone; *S. & C.* to collections made by Seaver and Chardon; *W. K. & T.*, collections made by Whetzel, Kern and Toro. The Sintenis specimens cited are all to be found in the herbarium of the N. Y. Botanical Gardens. All specimens of Stevens' collection, "Porto Rican Fungi," Herbarium, University of Illinois, deposited in the New York Botanical Garden Herbarium, are cited as *St.* In some cases the specimens of other collectors are also specifically referred to in which case the collector's name with the number on the packet are given as in the case of collections by Clinton, Stevenson, Johnston, Tucker, etc. Not all of the specimens of such collectors are referred to, only those being cited which appear to be of special interest.

Order USTILAGINALES

Family 1. USTILAGINACEAE

USTILAGO (Pers.) Roussel. Fl. Calvados ed. 2, p. 47. 1806

USTILAGO AFFINIS Ellis & Ev.; Cockerell, Bull. Torrey Club **20**: 297. 1893.

Ustilago Hilariae P. Henn. Hedwigia **37**: 267. 1898.

Ustilago Stenotaphri P. Henn. Hedwigia **37**: 293. 1898. (Not *U. Stenotaphri* of McAlpine.)

Ustilago americana Speg. Anal. Mus. Nac. Buenos Aires **6**: 207. 1899.

Ustilago Henningsii Sacc. & Sydow, in Sacc. Syll. Fung. **16**: 368. 1902.

On *Stenotaphrum secundatum* (Walt.) Kuntze.

One of the commonest smuts in Porto Rico and Vieques: Known also from Bermuda, Jamaica and Mexico.

USTILAGO SCHRÖTERIANA(?) P. Henn. Hedwigia **35**: 215–216. 1896.

On *Paspalum* sp. Johnston N. Y. Bot. Gard. *(4)641*; Rio Piedras Exp. Sta. P. R. *4641*.

Referred by Stevenson (Jour. Dept. Agr. Porto Rico **2**: 162. 1918) to *Sphacelotheca Paspali-notati* under which see: Type from Brazil.

USTILAGO SEGETUM Dittm.

A smut is listed under this name by Klotzsch (**1852**: 364) from Schwanecke's Porto Rican collections. No host is given. As this is an old name applied collectively to the smuts of cereals it is impossible to determine just what species he had. His specimen has not been seen.

USTILAGO TRITICI (Pers.) Rostr. Overs. Danske Vid. Selsk. Forh. **1890**: 15. March 1890.

Uredo segetum Tritici Pers. Tent. Disp. Fungi. **57**. 1797.

Ustilago segetum Tritici Jens. Om Korns. Brand 61. 1888.

Ustilago Tritici Jens.; Kellerm. & Swing. Ann. Rep. Kansas Exp. Sta. **2**: 262. June 1890.

Ustilago Tritici f. folicola P. Henn. Zeitschr. Pflanzenkr. **4**: 139. 1894.

On *Triticum aestivum* L. (= *T. vulgare* Vill.).

But one collection of this smut is known to the writers from Porto Rico, that by C. M. Tucker his number *300* (= Cornell Univ. Herb. No. *14936*). Common in all temperate regions where wheat is grown.

USTILAGO ZEAE (Beckm.) Unger. Einfl. Bodens. 211. 1836.

Lycoperdon Zeae Beckm. Hannov. Mag. **6**: 1330. 1768.

Ustilago Maydis Corda, Ic. Fung. **5**: 3. 1842.

Ustilago Zeae-Mays Wint. Rab. Krypt.-Fl. **1^1**: 97. 1881.

On *Zea Mays* L.

Reported by Clinton (**1906**: 15) from Porto Rico but not represented in his 1904 collection. Reported also by Stevens (**1917**) *5812* and Stevenson (**1918**) *6618*. There is also a specimen in the collection of C. M. Tucker, *301*.

Apparently not common in Porto Rico: Occurring wherever maize is grown.

SPHACELOTHECA De Bary, Verg. Morph. Biol. Pilze, p. 187. 1884

SPHACELOTHECA PANICI-LEUCOPHAEI (Bref.) Clinton, N. Am. Fl. **7**: 28. 1906.

Ustilago Panici-leucophaei Bref. Unters. Gesammt. Myk. **12**: 114. 1895.

Ustilago insularis P. Henn. Hedwigia **35**: 51. 1896.

On *Valota insularis* (L.) Chase. *W. & O. 451, 453; W. K. & T. 2131, 2140, 2147; St. 40, 1368, 4297; N. Y. Bot. Gard. 563.*

The entire inflorescence is converted into a dull brown dusty mass as it emerges from the upper leaf sheath. A very common smut in Porto Rico and Vieques: Reported also from Cuba, Jamaica, Central and South America, Mexico and Arizona.

SPHACELOTHECA PASPALI-NOTATI (P. Henn.) Clinton, Jour. Myc. **8**: 140. 1902.

Ustilago Paspali-notati P. Henn. in Herb. Holway. Clinton, Jour. Myc. **8**: 140. 1902.

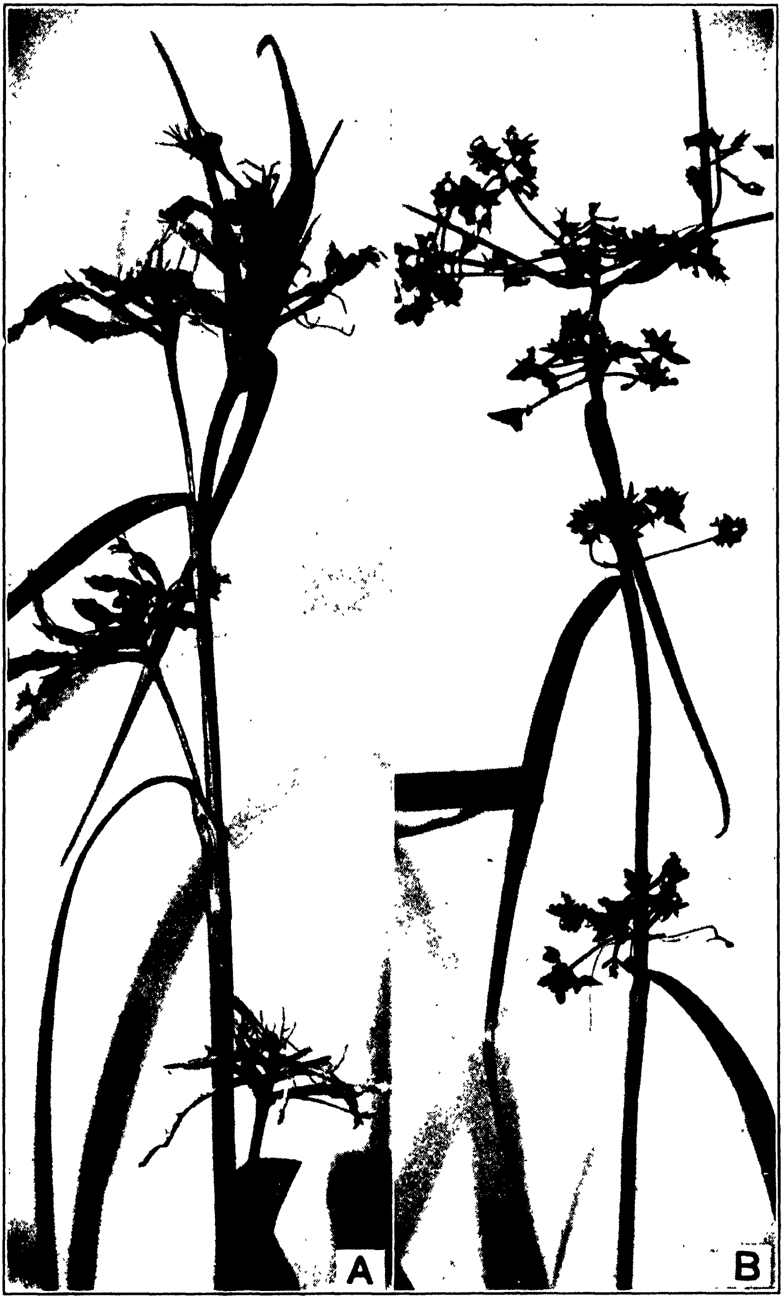
On *Paspalum* sp.

Recorded in Porto Rico by Stevenson from near Rio Piedras (**1918**: 162). No specimen of this was found in Stevenson's private collection: His record is presumably based upon a specimen under this name (*4641*, Herb. Exp. Sta. Rio Piedras, P. R.) part of which is now in the N. Y. Botanical Garden Herbarium, (*4*)*641*, collected by J. R. Johnston near Rio Piedras, Dec. 21, 1912. The host is evidently a *Paspalum* but the species cannot be determined with certainty. It is clearly not *P. notatum*. The spores of this smut are much larger than those of the type specimen of *S. Paspali-notati*. It is, according to H. S. Jackson (letter Nov. 23, 1925), probably *Ustilago Schroeteriana* P. Henn. (Hedwigia **35**: 215–216. 1896), the type specimen of which has not been seen; it is probably in the Berlin Museum: *S. Paspali-notati* is known only from the type locality in Mexico.

SPHACELOTHECA SORGHI (Link) Clinton, Jour. Myc. **8**: 140. 1902.

Sorosporium Sorghi Link, in Willd. Sp. Pl. **6**^{2}: 86. 1925.

Tilletia Sorghi-vulgaris Tul. Ann. Sci. Nat. III. **7**: 116. 1847.



A. CINTRACTIA LEUCODERMA (BERK.) P. HENN.
B. CINTRACTIA UTRICULICOLA (P. HENN.) CLINTON

Ustilago Sorghi Pass. Thüm. Hedwigia **12**: 114. 1873.
Ustilago Tulasnei Kühn, Ber. Sitz. Nat. Ges. Halle **1874**: 5. 1874.
Cintractia Sorghi-vulgaris Clinton, Bull. Ill. Exp. Sta. 47: 404. 1897.
On *Holcus Sorghum* L. (*Sorghum vulgaris* Pers.).

A single collection by C. M. Tucker *258*, (= Cornell Univ. Herb. *12638*) is known to the writers from Porto Rico: Known also from Cuba, Jamaica, Canada, United States, Europe, Asia and Africa.

CINTRACTIA Cornu, Ann. Sci. Nat. VI. **15**: 279. 1883

CINTRACTIA AXICOLA (Berk.) Cornu, Ann. Sci. Nat. VI. **15**: 279. 1883.
Ustilago axicola Berk. Ann. Mag. Nat. Hist. II. **9**: 200. 1852.
Ustilago Fimbristylis Thüm. Bull. Torrey Club **6**: 95. 1876.
On *Fimbristylis diphylla* (Retz.) Vahl. *Clinton 47; S. & C. 2039; W. K. & T. 2135, 2139, 2141, 2143; Johnston N. Y. Bot. Gard. 906a; St. 1874, 4838, 5821, 1881, 5818, 4538, 5033, 5162, 5729, 668; Stevenson (N. Y. Bot. Gard.) 2179, (N. Y. Bot. Gard.) 748a; (N. Y. Bot. Gard.) Fishlock 67.*
On *Fimbristylis ferruginea* (L.) Vahl. *W. K. & T. 2142; St. 1798.*

The second named host appears to be a new one for this smut. Very common in Porto Rico. Also recorded from St. Thomas (Seaver **1924**: 10) and Tortola *N. Y. Bot. Gard. 748a* and *Fishlock 67:* Southern U. S.; Mexico, Central America, Cuba, Jamaica, Santo Domingo and St. Kitts.

CINTRACTIA LEUCODERMA (Berk.) P. Henn. Hedwigia **34**: 335. 1895.
Ustilago leucoderma Berk. Ann. Mag. Nat. Hist. II. **9**: 200. 1852.
Cintractia Krugiana P. Magn. Bot. Jahrb. **17**: 490. 1893.
Cintractia affinis Peck, N. Y. State Mus. Bull. **67**: 28. 1903.
On *Rynchospora corymbosa* (L.) Britton. PLATE 16, FIG. A. *S. & C. 2028; W. K. & T. 2134; St. 9277, 836,* (*5254a, 5254, 5782, 5610,* probably this host, may be *R. gigantea;*

material too scant for accurate determination). *Johnston 1168; Stevenson 6408, 2208* (?).

On *Rynchospora cyperioides* (Sew.) Mart. *W. & O. 454; S. & C. 2046.*

On *Rynchospora gigantea* Link. *Sintenis 6672* Type.

There are in the New York Botanical Garden Herbarium, marked Ellis Collections, two specimens of *C. leucoderma* from Porto Rico on *R. gigantea* apparently duplicates from Sintenis' collection since one is a part of the type cited by Magnus in his original description of *C. Krugiana 6672*, the collectors being Krug and Urban. The other specimen collected at Manati by the same collectors bears no number. Neither are dated. These are the only specimens known with certainty to have been taken on this host in Porto Rico.

Easily recognized by the long white covered sori which involve the pedicles and peduncles of the inflorescence. *R. cyperioides* appears to be new for this smut.

Locally very abundant in Porto Rico on *R. corymbosa* especially along streams about San Juan. Often occurring along with *C. utriculicola* on this host: Florida, New York, Cuba, Isle of Pines, Santo Domingo, Mexico, South America, Central America, Asia and Australia.

CINTRACTIA LIMITATA Clinton, Proc. Boston Soc. Nat. Hist. **31**: 399. 1904.

On *Cyperus ligularis* L. (*Mariscus ligularis* Urban). *Clinton 3; 167* (part in N. Y. B. G.); *St. 5309, 4854, 1852, 1850.*

Apparently common. Known only from Porto Rico; Mayaguez, Manati, Santurce, Boqueron and San Juan being the stations represented in the collections seen.

CINTRACTIA MINOR Jackson, Mycologia **12**: 153. 1920.

Cintractia axicola minor Clinton, Jour. Myc. **8**: 143. 1902.

On *Cyperus sphacelatus* Rottb. *Clinton 117; Johnston & Stevenson* (*N. Y. Bot. Gard.*) *1513; W. & O. 455, 456; W. K. & T. 2138.*

This appears to be a rather uncommon species in Porto Rico. The only other places from which it is reported are New York, New Jersey and Delaware where it occurs on *Cyperus Grayii* (Jackson, Mycologia **12**: 153).

CINTRACTIA UTRICULICOLA (P. Henn.) Clinton, Jour. Myc. **8**: 143. 1902.

Cintractia leucoderma, f. urticulicola P. Henn. Hedwigia **34**: 336. 1895.

Cintractia axicola, f. spicularum Juel, Bih. Sv. Vet.-Akad. Handl. **23** (3) 10: 7. 1897.

On *Rynchospora corymbosa* (L.) Britton (*Rynchospora aurea* Vahl). PLATE 16, FIG. B. *W. K. & T. 2133; St. 1061a, 6783; Seymour & Earle, Ec. F. C105*, coll. by Clinton 1904; *N. Y. Bot. Gard. 6967.*

Occurring frequently along with *C. leucoderma* on *R. corymbosa*. Apparently not common in Porto Rico: Known also from Mexico, Trinidad and South America.

MYKOSYRINX G. Beck, Ann. Nat. Hofmus. Wien **9**: 123. 1894

MYKOSYRINX CISSI (DC.) G. Beck, Ann. Nat. Hofmus. Wien **9**: 123. 1894.

Uredo Cissi DC. in Poir. Encycl. Meth. Bot. **8**: 228. 1808.

Geminella exotica Schröt. Hedwigia **15**: 135. 1876.

Schroeteria Cissi De-Toni, Sacc. Syll. Fung. **7**: 501. 1888.

On *Cissus erosa* L. C. Rich (Cited as *190* of Sintenis by Magnus **1893**: 189. No specimen of this in N. Y. Bot. Gard. herbarium).

On *Cissus sicyoides* L. *Sintenis, 1886.*

On *Cissus trifoliata* L. (*C. acida* L.). *N. Y. Bot. Gard. 4795, Sintenis 791, Ricksecker*, St. Croix *406.*

On *Cissus* sp. Syd. Ustilag. *48, Sintenis 3004, N. Y. Bot. Gard. 513.*

While this species would appear to be common in Porto Rico, judging from the number of collections of it taken by earlier collectors, it is remarkable that it appears not to have been found by Stevens or any of the succeeding collectors. A single specimen is known from St. Croix: Florida, Mexico, Cuba, Isle of Pines, Bahamas, Jamaica, Santo Domingo, Trinidad, Central America, South America and Africa.

THECAPHORA Fingerh. Linnaea **10**: 230. 1835

THECAPHORA PUSTULATA Clinton; Chardon, Revista Agr. P. R. **6**^{4}: 21–23. 1921.

On *Bidens pilosa* L. (*B. leucantha*). *Stevenson* (*N. Y. Bot. Gard.*) *5977; W. & O. 458; Char. 983; W. K. & T. 2136, 2137, 2144.*

Causing soft gall-like swellings of various sizes up to an inch in diameter on stems, leaves and petioles.

Frequent throughout Porto Rico. Not known elsewhere.

TOLYPOSPORELLA Atk. Cornell Univ. Exp. Sta. Bull. **3**^{1}: 16. 1897

TOLYPOSPORELLA BRUNKII (Ellis & Gall.) Clinton, Jour. Myc. **8**: 147. 1902.

Ustilago (*Sorosporium?*) *Brunkii* Ellis & Gall. Jour. Myc. **6**: 31. 1890.

Ustilago apiculata Ellis & Gall.; Jennings, Texas Exp. Sta. Bull. 9: 29. 1890.

On *Andropogon bicornis* L. *W. & O. 449.*

Black linear sori mostly along midrib of leaf, underside. Known in Porto Rico from the single collection by Whetzel & Olive No. *449* from E. Yunque: Reported from Texas and Mexico.

Tolyposporella Sporoboli Jackson n. sp.

Sori on outer surface of leaf sheaths and on (apparent) upper surface of leaves, forming linear striae 1–10 mm. long, scattered and usually not confluent, epidermis usually rupturing along one side, conspicuous, cinereous; spores variable in size, somewhat irregularly globoid, 10–15 μ in diameter, more or less agglutinated but not in definite spore balls, outer wall often drawn out to a point on one side so that the spores appear pyriform and then up to 18 μ long, often in pairs; wall chestnut brown, smooth, 2.5–4 μ thick.

On *Sporobolus indicus* (L.) Br. E. Yunque, Porto Rico, Apr. 14, 1916, *W. & O. 450* Type.

This species differs from the other species of this genus which have been described, primarily in the character and position of the sori. Superficially the smut resembles the telial stage of a rust.

Family 2. TILLETIACEAE

UROCYSTIS Rab.; Klotzsch, Herb. Viv. Myc. ed. 2. *393.* 1856.

UROCYSTIS CEUPLAE Frost; Farl. Ann. Rep. Sec. Mass. Bd. Agr. **24**: App. 195. 1877.

On *Allium Cepa* L.

Mentioned by Henricksen (1906). No specimens of this fungus from Porto Rico known. According to Stevenson (**1918**: 163) this smut probably does not occur there.

ENTYLOMA De Bary, Bot. Zeit. **32**: 101. 1874

ENTYLOMA AUSTRALE Speg. Anal. Soc. Ci. Argent. **10**: 5. July 1880.

Protomyces Physalidis Kalchb. & Cooke, Grevillea **9**: 22. Sept. 1880.

Entyloma Besseyi Farl. Bot. Gaz. **8**: 275. 1883.

Entyloma Physalidis Wint. Hedwigia **22**: 130. 1883.

On *Physalis pubescens* L. (Host determined by N. L. Britton). *Clinton 132* (N. Am. Fl. **7**: 64); *W. & O. 491, 489, 488.*

Known from Porto Rico only in the above cited collections: United States, Canada, South America and Africa.

ENTYLOMA GUARANITICUM Speg. Anal. Soc. Ci. Argent. **17**: 127. 1884.

On *Bidens pilosa* L. (*B. leucantha*). (*Clinton no number*); *W. K. & T. 2145, 2146; Seym. & Earle, Ec. Fungi C 107* collected by Clinton 1904.

Pale white spots on the leaves.

There are but four collections of this from Porto Rico known to the writers. Probably common especially at high altitudes. Inconspicuous and hence easily overlooked: Known also from Massachusetts (?), Florida and South America.

ENTYLOMA LOBELIAE Farl. Bot. Gaz. **8**: 275. 1883.

On *Lobelia Cliffortiana* L. *Clinton 134.*

Clinton's collection is the only one known to the writers from Porto Rico. This was reported by him as on *Lobelia* sp. (N. Am. Fl. **7**: 64). The writers submitted Clinton's specimen for determination to Dr. N. L. Britton, who identifies it as *L. Cliffortiana:* Known otherwise only from N. America on *Lobelia inflata.*

BURRILLIA Setch. Proc. Am. Acad. **26**: 18. 1891

BURRILLIA ECHINODORI Clinton, Jour. Myc. **8**: 154. 1902.

On *Echinodorus cordifolius* (L.) Griseb.

A single collection, *335*, was made by Stevens in Porto Rico. Duplicates of this collection were distributed by Bartholomew in *Fungi Columb. 5002*. There is also a specimen in the private collection of John A. Stevenson *3838* a part of which is deposited in Cornell Univ. Herb. under No. *14935*. Apparently rare: Known also from Florida and California.

DOASSANSIA Cornu, Ann. Sci. Nat. VI. **15**: 285. 1883

DOASSANSIA SINTENISII Bres. Bot. Jahrb. **17**: 489. 1893.

On *Cedrela odorata* L.

Clinton (**1906**: 71) excludes this species, remarking "Probably insect work." There are three specimens apparently all of the same collection of this from the Sintenis collection in the N. Y. Bot. Gard. Herbarium all dated 1887, collected at Utuado. A careful examination of these specimens confirms Clinton's diagnosis.

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A BIT OF POLYNESIAN MYCOLOGY

THOMAS H. MACBRIDE

The material basis for these brief notes consists of two specimens of *Stemonitis* collected in Suva by Professor A. O. Thomas, and a fine box of mounted material, chiefly myxomycetal, collected and prepared by Dr. G. H. Cunningham of New Zealand, and sent to the University of Iowa by the hand of Professor R. B. Wylie, in September, 1922, with a second packet arriving a few months later.

These materials are interesting in many ways. The regions, of course, are well isolated, not only from each other, but also from the continental masses of the northern world. Island habitats both; New Zealand, because of size, age and topographic structure, offers an indigenous flora, abundant, rich, varied, three fourths of it unique, tracing perhaps to a previous geologic period.

Furthermore, for the last one hundred and fifty years the introduction of alien plants has for these regions been constant, due to the increasing occupancy of the country by Europeans. More recently, in New Zealand, in an effort at reforestation, large areas are planted with foreign species, among which the Californian *Pinus radiata* has, just now, a very important place.

Viti, or Fiji, is in practically the same situation; not so large, innovations whether of plants or ideas have naturally not been so early nor so great; but for a century, ships,—notably of the United States long ago,[1] and increasingly from England, since 1871,—have introduced all manner of plants useful in civilized life. Results concerning the distribution of mycologic species are now to be expected. Let us consider the Myxomycetes first and begin with the larger collections, those from New Zealand.

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[1] 1838–43. Vide Rep. Wilkes and Hale Exploring Expedition. Vol. 3.

I. MYXOMYCETES FROM NEW ZEALAND[2]

1. BADHAMIA UTRICULARIS (Bull.) Berk.

Specimens so referred have the characteristic spores, in size and in tendency to adhere in varying clusters. In one respect however one of Mr. Cunningham's gatherings differs pronouncedly from any specimens of *B. utricularis* I have so far examined. I find in the sporangia now and then a strong columella, quite as in *Craterium* for instance, or the more decidedly columellate species of *Physarum*. This peculiarity may result from meteoric conditions at the time of maturing. Future collections must determine.

*2. BADHAMIA CAPSULIFERA Berk.

This species is represented by a very peculiar phase. The adherent spores are in all respects normal, but the fructification as a whole is erionemoid! The sporangia are small, distributed as bead-like enlargements of the flaccid and thread-like, far-extended stipe. When blown out, as the material before us is, the resemblance is to *Erionema*.

This may be an unusual presentation; if not, it deserves recognition as varietal at least;—*B. capsulifera* Berk. form—*monilifera*.

*3. PHYSARUM STRAMINIPES Lister.

This is a beautiful, easily recognized species, distinguished by the long yellowish membranaceous stalks and especially by the unequal distribution of warts upon the epispore, giving to the entire surface a very peculiar spotted appearance.

Hitherto reported from western Europe only.—Imported from England?—or, is England importing?

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[2] For our knowledge of mycologic flora in the south sea islands, we have until recently depended almost entirely upon the publications of Rev. M. J. Berkeley (1853–59) known throughout the world. He and his associates are responsible for a large part of current nomenclature in the subject, so far as referable to English sources.

More recently, however, Mr. Lister (Jour. Bot. London **43**: 111–114. 1905) has published a list of New Zealand slime-moulds, and these are mentioned as well in the second edition of the "Mycetozoa"; 1911.

In the present list the (*) indicates forms not hitherto reported from the regions named, so far as shown by the lists cited, supplemented by Saccardo references.

4. PHYSARUM LEUCOPHAEUM Fries.

To arouse liveliest discussion this species needs only to be named. Described first by Fries a century ago, in literature it dips in and out of view in fashion quite surprising. The erect pose, due to a flat sporangium base, and rather stout short stem seem to distinguish the form. In New Zealand apparently all these characters are emphasized; we have, indeed, a phase properly described as robust, had that term not already been applied in description of another species of the genus. The form before us is larger, stouter, more vigorous looking in every way, but in essential points the same as the Friesian type.

*5. PHYSARUM VIRIDE Pers.

This familiar species is also represented by sporangia larger and more rigid than have been seen, at least in collections in America.

6. CRATERIUM MINUTUM (Leers) Fries.

Three colonies are at hand varying somewhat with each other, badly weathered, open and more or less yellow; a not unusual variation.

*7. DIDERMA HEMISPHERICUM (Bull.) Hornem.

Weathered but typical.

8. DIDYMIUM SQUAMULOSUM (Albert. & Schw.) Fries.

Typical.

*9. LAMPRODERMA VIOLACEUM (Fries) Rost. var. *Sauteri* Rost.

This is an old-world species. The form *L. Sauteri* R. a variety only.

*10. COMATRICHA NIGRA (Pers.) Schröt.

11. COMATRICHA TYPHOIDES (Bull.) Rost.

12. STEMONITIS AXIFERA (Bull.) Macbr.

*13. STEMONITIS FLAVOGENITA Jahn.

*14. ENTERIDIUM LICEOIDES List.?

E. liceoides is thought closely related to *E. olivaceum* Rost.

The material before us, if here properly referred, does not support that view. *E. olivaceum* shows a small, definitely depressed, thin aethalium, with the internal structure much as in *E. splendens* Morg. In the present gathering, the aethalia are associated, and of varied form and size, from hemispherical—when smaller—to irregular, depressed and some 2 or 3 cm. in extent. In the smaller, so far as examined, no capillitial structures appear; in the larger, certain nondescript, irregularly perforate strands occur sparingly. The adherent spores in either case are similar to those of *E. olivaceum*, but have longer spines. The absence of capillitium in the globose aethalia suggested no doubt the specific name *E. liceoides;* in the present gathering the globose fructifications are liceas with spinulose spores.

15. Lycogala epidendrum (Buxb.) Fries.

Cosmopolitan, as would appear.

16. Arcyria incarnata Pers.

Typical.

17. Arcyria denudata (L.) Sheld.

18. Hemitrichia serpula (Scop.) Rost. var.?

The plasmodiocarp is not very different from that of the common species, the color inclined to brown; the dehiscence lateral, the capillitial thread netted with few free ends, these abrupt and hamate, *thoroughly spinescent,* the spinules 1–3 μ; the spores netted, 3–5 on the hemisphere, 9–12 μ; the equatorial circle about $\frac{1}{3}$ μ in width.

Differs from the type in larger dimensions throughout. Further collection must determine the real significance and persistence of the peculiarities noted.

19. Trichia varia (Pers.) Rost.

20. Trichia verrucosa Berk.

21. Trichia decipiens (Pers.) Macbr.

22. Trichia lateritia Lév.

A second sending of Myxomycetes from Mr. Cunningham came recently to hand; this included the species following:

1. **Badhamia calvescens** n.s.

Fructification closely gregarious; sporangia dark grey, ovate or cylindric, sessile, or narrowed below, but not strictly stipitate; about 1 mm. high, with apical dehiscence; the capillitium dense, the tubules very short, the nodes large, irregular, white, physaroid, more or less aggregate at the center, otherwise no columella; spores dark violaceous, coarsely spinulose, thick-walled save for a limited area apparently thinner, but bearing a few scattered spinules, 12–14 μ.

Resemblance is with *B. papaveracea* (Berk.) Rost.; the spores are adherent in fours, apparently; but there are no stems and the sporangia are cylindric or irregularly prolate.

2. PHYSARUM GLOBULIFERUM (Pers.) Rost.?

This species, believed cosmopolitan, varies constantly. Many varieties have been recognized in the United States. The variations affect the color of the peridium, the length and to some extent the structure of the stipe, etc.

The present gathering is not exceptional; it simply suggests a new variety!

The fructification is loosely gregarious, stipitate; the sporangia more or less globose, often flattened below; the peridium smooth, persistent, white; the stipe not long, but longer than the diameter of sporangium, terete and fluted or flat, strand-like, white or pallid; columella slight or obsolete; capillitium regular, the nodes white and small, uniform, ellipsoidal, the connecting filaments persisting, tubular; spores violet-brown, delicately verruculose, 8 μ.

The peridial and stem characters are divergent from the type; the capillitium and spores typical. Reference provisional.

*3. DIDYMIUM XANTHOPUS (Ditmar) Fries.

A common and widely distributed species.

II. MYXOMYCETES FROM SUVA

1. STEMONITIS HERBATICA Peck.

This species is based upon material originally collected in New York in 1874; not common in other parts of the American continent. Now here, behold it in mid-ocean on the opposite side of the world!

The question is, is it in Suva indigenous? It does seem unlikely that the species originates where now discovered; it was more probably introduced within the last fifty years. Wilkes, as noted, visited and in 1840 made a survey of the Viti group; but he was two years en route, too long for viable spores, it is believed. If introduced, the case is more recent; the journey is now accomplished in thirty days.

2. STEMONITIS FUSCA Rost., form VERRUCULATA.

This species, in one phase or another, is common in the forests of the northern world. As now identified it is made to include forms not falling definitely within the Polish description, 'spores smooth'! no; but as well, forms having spores netted, and finally, netted and spinulose! The spinules rise, when present, as slender, acicular spines from the mesh-corners of an episporic net.

In the form before us the epispore betrays no net, no spines, but verruculae instead. Otherwise the specimens do not very much differ from American types of *S. fusca* Rost. as at present constituted for western Europe.

To conclude this brief discussion of a fine list of most interesting myxomycetal forms, it will be not wholly inappropriate to refer here to certain minor, inconspicuous but none the less elegant hyphal sporocarps which everywhere masquerade in the garb or physiognomy of slime-mould species. These are always interesting; those now at hand especially so, as may appear.

That such wrong association should at all be possible is largely due no doubt to sheer unskilfulness of those who in such cases write descriptions; perhaps a little, besides, to Nature's quite economic use of her several elements of beauty. Of beauty, as of its correlative truth, there has apparently never been enough in this world to go around; not quite,—and so form-mimicking is possible. That is to say, in form, or color, or in some peculiar character very different small organisms offer betimes an outward surface-resemblance to each other, and no description can be drawn so infallible in wording as to admit of no misapplication.

Accordingly solenias, small puff-balls, hyphomycetes in various forms often claim as against sessile forms of *Trichia*, *Lycogala*, *Enteridium*, etc. The difference is basic; the first-named forms are fungi, the latter slime-moulds, to start with.

To the student both groups are of equal interest. To illustrate we may close our present study with a mention of two or three of these mimic fungi.

1. PILACRE DIVISA Berk.

Fructification scattered or gregarious; the sporocarp grey-ferruginous, more or less pilose, depressed-globose, umbilicate below; in greater diameter 1–3 mm.; stipe grey, stout, tapering upward, then enlarged and separating into two or more branches entering as one the umbilicate sporocarp, height 2–5 mm.; sporules subglobose, thick-walled, bright ferruginous, smooth, catenulate in 8s (?), 5–7 μ.

Reported by Berkeley from Bay Islands, New Zealand, in 1876. The present specimens are from the same locality. So far as appears, this is the first notice of the species since Berkeley.

2. **Coremium gracile** n.s.

Fructification consisting of stipitate sporocarps, scattered, inclined to be closely gregarious; the capitula ovoid or spherical, becoming prolate; at first dark brown, paler at top, girt with white below, at maturity wholly white with falling spores, small, about 1/4 × 1/6 mm.; stipe clear brown, rigid, erect, even, 1.5–2 mm.; spores catenulate, smooth, 4–5 μ. N. Zealand.

3. CALONECTRIA POLYTHALAMA (Berk.) Sacc.

This handsome little species was described, it is believed, by Berkeley in 1876, from Bay Islands, New Zealand. It occurs also, strangely enough, in the southern forests of United States, Mississippi, Alabama. See above, record of No. 1.

IOWA CITY, IOWA

SKETCHING FLESHY FUNGI WITH THE AID OF THE CAMERA LUCIDA[1]

LOUIS C. C. KRIEGER

(WITH PLATE 17)

In order to complete the record of a fleshy fungus mycologists are sometimes called upon to make drawings. As free-hand sketching is not usually one of their accomplishments, an account of a simple method for obtaining accurate outlines with little effort and practically no skill may be of interest. An instrument that few laboratories lack, the camera lucida, together with a chemist's ring stand, is the equipment.

While engaged in painting cacti (*Opuntia* species) at Chico, California (1912–1917), for the U. S. Department of Agriculture, under the direction of Dr. David Griffiths, the writer, at the suggestion of this gentleman, employed light, photographic platinum-prints as a basis for the superimposed color-work on the flat-jointed (*Platyopuntia*) species. Others, of the "cholla" (*Cylindroöpuntia*) type, and the buds, flowers, and fruits of nearly all species indiscriminately, were at first drawn free-hand, and then colored. The latter procedure proved time-consuming, and a means was sought to expedite the preliminary drawing of so much complicated detail. Having had occasion to use the camera lucida in drawing microscopic objects, it occurred to the writer that this instrument might be turned to account.

A camera of the type in which the prism-chamber (Pl. 17, *e*) is inclinable on a hinge, made adaptation to macroscopic drawing an extremely easy matter, the chemist's ring-stand serving as the support. The latter consists of a vertical, twenty-four-inch steel rod (*a*) that fastens into a lacquered-iron base (*l*), and of several iron rings (*h*, in dotted lines) that may be moved up and down on the rod and secured at any point thereon by means of a screw (*m*). Only one ring, a large one, was retained to hold a

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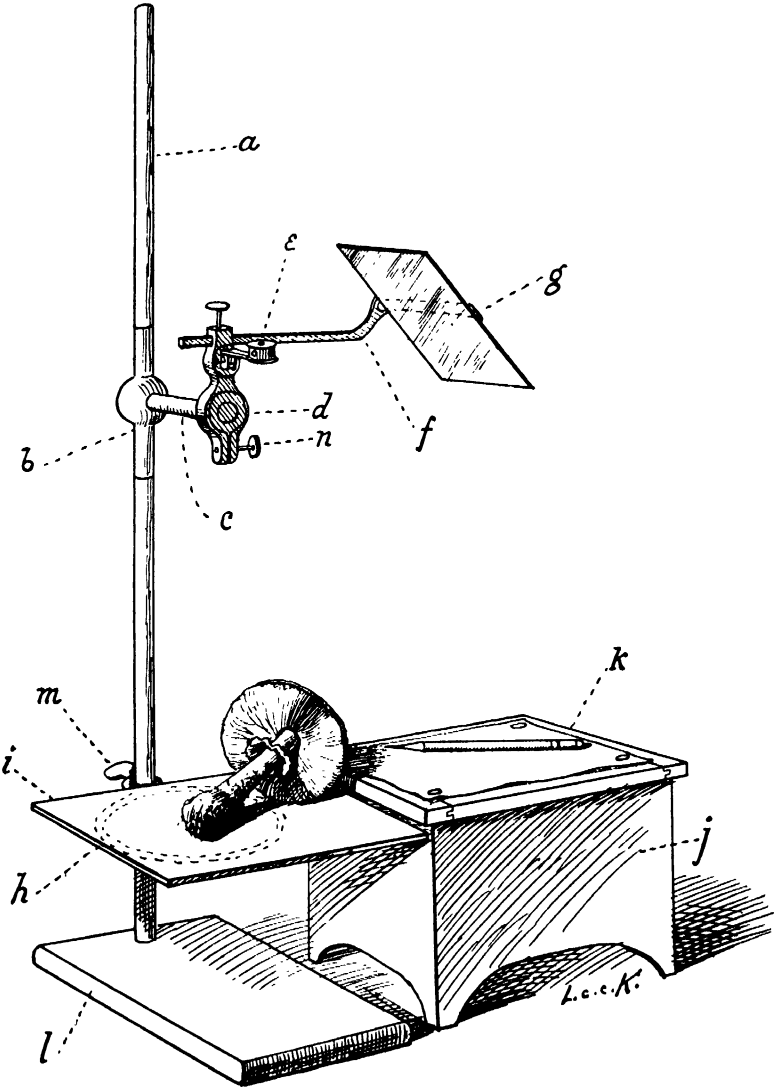
[1] Contribution from The Howard A. Kelly Mycological Library, Baltimore, Md.


a
ε
g
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L.c.c.K.

thin board (*i*), the platform, on which the *Opuntia* joint, bud, or fruit was placed.

Another item was a piece of steel tubing (*b*), about three inches long, and of a diameter that permitted one to move it up and down on the steel rod with ease, and yet without any perceptible looseness in the fit. From the middle of this piece of tubing, and at right angles to it, projected a solid, cylindrical, iron arm (*c*), the free end of which formed the point of attachment for the ring-clamp (*d*) of the camera, the part that ordinarily clasps the microscope tube. As the diameter of the iron arm was considerably less than that of the ring-clamp, a piece of hard ink-rubber was perforated with a circular hole the exact size of the iron arm. This done, the rubber was slipped on the arm and then pared down with a knife to about the diameter of the inside of the open ring-clamp. When the screw (*n*) was tightened, the camera was securely held in the correct position. It only remained to set the prism-chamber at right angles to the ring-clamp, and to place the square mirror-rod (*f*) into the hole made for its reception, so that the metal axis (*g*) upon which the mirror revolves was again in the horizontal position, and the apparatus was ready for use.

The box (*j*) seen at the right of the instrument carries a small drawing-board (*k*) on which the drawing-paper is fastened. This drawing-plane can be raised or lowered by using taller or shorter boxes, care being taken, however, that there is no variation in the height of the plane once it is fixed.

Since the iron ring that carries the thin board for holding the objects can also be raised or lowered, it will be seen at once that one can draw either at natural size, or, within limits, on a larger or smaller scale.

It may be added that distortion must be guarded against. This is best done by drawing two circles on separate pieces of paper, one to be placed on the object-holding board, the other on the drawing-board. The outer edge of the latter is then raised or lowered until the circle on it ceases to appear longitudinally elliptical, even to the slightest degree.

This contrivance having saved the writer immense labors, he trusts that others may be similarly benefited.

1406 EUTAW PLACE, BALTIMORE, MD.

NOTES AND BRIEF ARTICLES

Mr. Robert Hagelstein, an active member in the New York Microscopical Society and an enthusiastic student of slime-moulds, is spending a part of the winter in Porto Rico collecting and studying the Myxomycetes. He is also assisting in the preparation of manuscript on this group for "The Mycology of Porto Rico and the Virgin Islands," a part of which is now in type.

The following notice has recently been received from Mr. Elam Bartholomew: "WITH THE ISSUANCE OF CENTURY 35 THE PUBLICATION OF NORTH AMERICAN UREDINALES IS HEREWITH DISCONTINUED." Mr. Bartholomew has done a great service to mycology in the years he has devoted to this work and mycologists will doubtless regret that it is necessary for him at this time to discontinue this valuable series of exsiccati.

Dr. Béla Husz, a member of the staff of the Experiment Station for Plant Pathology at Budapest, has been granted a fellowship by the International Education Board of New York for the purpose of studying fungous diseases and disease resistance in the United States. Doctor Husz has worked several months at the Minnesota Agricultural Experiment Station and is now studying in the Office of Pathological Collections, Bureau of Plant Industry, U. S. Department of Agriculture, where he is investigating the life histories of fungi.

Dr. F. D. Kern of Pennsylvania State College and Acting Dean of Agriculture in Porto Rico, Carlos E. Chardon, Commissioner of Agriculture of Porto Rico, and Mr. Rafael A. Toro, Assistant Pathologist in the Insular Experiment Station, sailed early in March for Santo Domingo for a five or six weeks collecting trip. Their time will be devoted to a collection and study of the fungi of that island.

There are students of mycology in general and students of Myxomycetes in particular who look forward to the culture-method of research, as alone likely to afford a sound basis for a taxonomy, at once satisfactory and permanent as far as such things go. All students of the chlorophylless plants become more and more conscious how entirely artificial our present classifications in scores of cases really are.

It is therefore from this point of view significant to read a paper recently presented by F. X. Skupiénski before the Warsaw Académie des Sciences, under the title: "Sur le cycle évolutif chez une espéce de Myxomycéte Endosporée, *Didymium difforme* (Duby)."

By a very ingenious series of cultures Mr. Skupiénski shows that the species studied is in fact heterothallic since it offers two sorts of spores from which proceed two kinds of myxamibic gametes. The union of the latter affords a resting zygote, from which we have later on the usual rapidly developing multinuclear plasmodium.

Mr. Skupiénski used carrot infusion agar as culture medium. He succeeded in sowing single spores. These in due time afforded zoospores and myxamibes, no plasmodium: When the products of two monospermous cultures were brought together in a third tube, the plasmodia appeared and went on to fructification. THOMAS H. MACBRIDE.

A NEW ILLUSTRATED MONOGRAPH OF THE BOLETACEAE OF CENTRAL EUROPE

Recent numbers of the Zeitschrift für Pilzkunde announce the prospective appearance of a critical and elaborately illustrated monograph of the Boletaceae of central Europe under the authorship of Franz Kallenbach, of Darmstadt, Germany. The work is to be issued under the joint auspices of the Deutsche Gesellschaft für Pilzkunde, the Deutsche Botanische Gesellschaft, and the Deutscher Lehrerverein für Naturkunde. It is to appear in about twenty parts, each part to contain two colored plates (quarto size) with text of approximately four pages. The price per part, to subscribers, is four marks, to others, five marks. Subscriptions are received by the treasurer of the Deutsche

Gesellschaft für Pilzkunde, Fritz Quilling, 28 Dreieichstrasse, Frankfurt a/M., Süd, Germany. LOUIS C. C. KRIEGER.

FOURTH INTERNATIONAL BOTANICAL CONGRESS

Investigators and teachers in the plant sciences, representing all aspects of botany, plant chemistry, plant pathology, bacteriology, agronomy, and forestry, are invited to attend the International Congress of Plant Sciences to be held at Ithaca, New York, August 16–23, 1926. This invitation is extended to all countries of the world. This Congress offers the first opportunity ever arranged in the United States for a general conference of all those professionally engaged in plant work. It possesses the additional compelling interest accruing from unrestricted international representation.

The Congress will be divided into about one dozen sections, each section with an invitation program occupying about four morning sessions. In the section for Mycology there will be arranged in addition several afternoon field trips or fungus forays to nearby points where the fungus flora is especially rich, and time will be set aside for round table or informal discussions.

Although the Congress is not to provide an occasion for legislation on regulatory matters of international significance (such as nomenclatorial rules), the organizing committee has expressly provided that "adequate opportunity shall be accorded all sections for the *discussion* of regulatory recommendations of international significance," in order that a better understanding may be reached for definite action at a subsequent international congress.

Communications concerning the section for Mycology should be addressed to the Secretary for the section. H. M. FITZPATRICK.

CORNELL UNIVERSITY,
ITHACA, NEW YORK

A BERMUDA HIGHWAY WITH ROYAL PALMS AND BERMUDA CEDARS

MYCOLOGIA

VOL. XVIII JULY–AUGUST, 1926 NO. 4

MYCOLOGICAL WORK IN THE BERMUDA ISLANDS

FRED J. SEAVER

(WITH PLATE 18)

Before 1912 little attention had been given to the fungi of the Bermuda Islands, in fact it was often stated that there were no fungi to speak of in those Islands. Previous to this time twenty-four species had been reported by the Challenger Expedition and a few collected and described by Dr. Farlow, including *Puccinia Lantanae* which is common there on the leaves of *Lantana involucrata.*

In November 1912 the writer was asked to accompany Dr. N. L. Britton of the New York Botanical Garden on a collecting expedition to those islands. About two weeks were spent in Bermuda and a goodly collection of fungi brought home for study. In addition to these about 40 species collected by Dr. and Mrs. B. O. Dodge previous to our visit were turned over to us. In 1916 a list of about 120 species was published in the Memoirs of the New York Botanical Garden (**6**: 501–511) which was the first attempt, so far as we are aware, to compile a complete list of the fungi known in that region.

Professor H. H. Whetzel spent an entire year in Bermuda, 1921–1922, in the employ of the Bermudian Government, the time being devoted to problems in plant pathology and a continuation of the survey of the fungi. His work greatly extended our knowledge of the fungi and it is the intention to publish a

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complete list at some future time. During the past winter the writer had the privilege of accompanying Professor Whetzel on a second collecting expedition, sailing from New York on January 9 and arriving home on February 15, the entire time being devoted to the collection and study of the fungi. More than three hundred collections were brought home for study.

While it is too early to give a finished report on this material, preliminary studies made at the Experiment Station have revealed a number of very interesting forms. It is the intention of the collectors to make a detailed study of the collection reporting on them at intervals in short technical papers which will be published in MYCOLOGIA.

When this work is finally completed, our knowledge of the fungi of Bermuda will probably be as complete as that of any other group of islands in the American Tropics or Subtropics except possibly Porto Rico and the Virgin Islands on which a great deal more time has been spent. While the number of species in Bermuda will naturally be much smaller, it will doubtless be relatively as complete as that of those islands.

The predominating tree in Bermuda is the Bermuda cedar, *Juniperus bermudiana*, which is distributed throughout the islands. In exposed situations it is often low and stunted, while under more favorable conditions it becomes a good sized tree, with the branches much more spreading than those of our native red cedar. The largest tree on the islands measures about 5 feet in diameter. We were naturally interested in the fungi which grew on and appeared to be restricted to this endemic host, and secured a surprisingly large number, some of which may themselves be new and endemic species.

Bermuda is a most beautiful place to visit especially for the naturalist, the quiet, restful atmosphere being especially conducive to scientific research. The illustration accompanying this article shows a typical road in these islands with the endemic cedar on the right and the royal palm an imported species on the left.

THE RUSTS OF SOUTH AMERICA BASED ON THE HOLWAY COLLECTIONS—I[1]

H. S. JACKSON

(WITH PLATE 19)

The following is a report on the identification of the rusts collected in South America by Prof. E. W. D. Holway and Mary M. Holway. The collections were obtained on two excursions, the first of which made in 1919 and 1920 included Ecuador, Bolivia, Peru and Chile. The second trip was made in 1921 and 1922 to Brazil and Argentina.

This is the first of a series of papers on the same subject. The reports will take up the rusts by families of the host plants in the order as given in Engler and Prantl.

Included in this report are the rusts obtained on both trips occurring on the ferns, and monocotyledons. The rusts on *Carex* are omitted as it is found impossible at this time to report on them in a satisfactory manner. The rusts on Poaceae have already been reported by Dr. J. C. Arthur (Proc. Am. Phil. Soc. **44**: 131–223. 1925.)

The combined collections consist of 2049 numbers, most of which are rusts. A few represent smuts or other fungi and a somewhat larger number were collected for Phanerogamic specimens. There were included, in the report by Arthur on the grass rusts, 464 of the Holway numbers, distributed among 58 rust species. The present report records 109 collections representing 49 species of rusts on 71 hosts.

The writer takes pleasure in acknowledging his great indebtedness to Mrs. Holway who has made it possible for him to make this study and who has given generously of her time in arranging and caring for the collections, and also to Dr. J. Arthur Harris for many courtesies. Acknowledgment is also due Drs. P. C. Standley and E. P. Killip who have determined most of the hosts.

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[1] Contribution from the Botanical Department of the Purdue University Agricultural Experiment Station.

SPECIES ON PTERIDOPHYTA

1. DESMELLA ANEIMIAE (P. Henn.) Sydow, Ann. Myc. **16**: 241. 1918.

Uredo Aneimiae P. Henn. Hedwigia **35**: 255. 1896.

Aneimia fulva (Cav.) Sw. Santa Anna, São Paulo, Brazil, May 28, 1922, *1900.*

Both uredinia and telia of this interesting rust are present in this collection.

2. PUCCINIA LYGODII (Hariot) Arth. Bull. Torrey Club **51**: 55. 1924.

Uredo Lygodii Hariot, Jour. de Bot. **14**: 117. 1900.

Dicaeoma Lygodii Arth. Bull. Torrey Club **51**: 55. 1924.

Lygodium volubile Sw. Rio de Janeiro, Brazil, Aug. 27, 1921, II, *1078.*

This is the third collection of this interesting species from South America. The type was collected at Pernambuco, Brazil, on *Lygodium* sp. Arthur (l.c.) reported it from near Bahia, Brazil, on *L. polymorphum* (Cav.) H.B.K.

3. UREDINOPSIS MACROSPERMA (Cooke) P. Magn. Hedwigia **43**: 122. 1904.

Uredo macrospermum Cooke, Grevillea **8**: 71. 1879.

Pteridium sp. Tijuca, Rio de Janeiro, Brazil, Aug. 19, 1921, II, *1059.*

This is the second collection recorded from South America; otherwise known only from Colombia.

SPECIES ON CYPERACEAE

4. PUCCINIA CYPERI Arth. Bot. Gaz. **16**: 226. 1891.

Dicaeoma Cyperi Kuntze, Rev. Gen. **3**^{3}: 466. 1898.

Cyperus cayennensis (Lam.) Britton. São Caetano, São Paulo, Brazil, Feb. 22, 1922, II, *1583;* Villa Augusta, Guarulhos R. R., São Paulo, Brazil, Feb. 25, 1922, II, III, *1595.*

Cyperus ferax L. C. Rich. San Felipe, Sur Yungas, Bolivia, May 19, 1920, II, III, *622*.

Cyperus Haspan L. Rio de Janeiro, Brazil, Dec. 20, 1921, II, *1411*.

Cyperus lenticularis (Schrad.) Steud. Lapa, São Paulo, Brazil, Feb. 27, 1922, II, III, *1601*.

Cyperus Olfersianus Kunth. Bello Horizonte, Minas Geraes, Brazil, Nov. 30, 1921, II, *1348*.

Cyperus sp. El Chaco, Sur Yungas, Bolivia, May 25, 1920, II, *648;* Therezopolis, Rio de Janeiro, Brazil, Oct. 11, 1921, II, *1210*.

Some of the collections are referred to this species with some doubt. We have included those with large urediniospores having two or three equatorial pores. In the collection on *C. Olfersianus* there are but two pores placed slightly above the equator. We are of the opinion that there are more species of *Puccinia* on *Cyperus* in South America than have yet been recognized. It is necessary, however, to have ample material of both uredinia and telia and many more collections before a satisfactory treatment of them can be made.

5. PUCCINIA CANALICULATA (Schw.) Lagerh. Tromsö Mus. Aarsh **17**: 51. 1894.

Sphaeria canaliculata Schw. Trans. Am. Phil. Soc. II. **4**: 209. 1832.

Dicaeoma canaliculatum Kuntze, Rev. Gen. **3**^{3}: 466. 1898.

Cyperus esculentus L. Cochabamba, Bolivia, Feb. 27, 1920, II, III, *339*.

While common in North America and the West Indies, this species has been recorded previously from South America only from British Guiana on *Cyperus* sp.

6. PUCCINIA SUBCORONATA P. Henn. Hedwigia **34**: 94. 1895.

Puccinia antioquiensis Mayor, Mém. Soc. Neuch. Sci. Nat. **5**: 472. 1913.

Cyperus diffusus Vahl. Villa Aspiazu, Sur Yungas, Bolivia, May 31, 1920, II, *693;* Rio de Janeiro, Brazil, Aug. 11, 1921, II, III, *1021;* Taquara, Rio de

Janeiro, Brazil, Aug. 30, 1921, II, III, *1083;* Jacarépaguá, Rio de Janeiro, Brazil, Sept. 4, 1921, II, III, *1089.*

An examination of the type collections of *P. subcoronata* P. Henn. and *P. antioquiensis* Mayor shows that they should be considered synonymous. The differences noted by Mayor do not hold when the ample material in the Holway collections is taken into account. The species is easily distinguished from other rusts on *Cyperus* by the small punctiform sori.

In the original account of *P. subcoronata* the rust is recorded on *Cyperus* sp. The specimen of the type distributed by Ule as no. *1485* Herbarium Brasiliense is labeled on *Cyperus diffusus* Vahl. Besides the type and the above listed collections, this species, always on *Cyperus diffusus*, is known also from British Guiana, Trinidad, and Colombia in South America, and from Costa Rica, Honduras, and Panama in North America.

7. **Puccinia flavo-virens** Jackson & Holway, n. sp.

II. Uredinia hypophyllous, scattered or gregarious on yellowish spots, subcircular or elliptic, large, 0.5–3 mm. across, tardily naked, pulverulent, long covered by the golden yellow epidermis; urediniospores ellipsoid, 16–18 by 24–28 μ; wall colorless or nearly so, thin, 1–1.5 μ, very finely and moderately echinulate, the pores obscure, 2 or 3, equatorial.

III. Telia hypophyllous, blackish brown, scattered or confluent and often covering large areas 1–5 mm. across, often surrounding the old uredinia, long covered by the epidermis; teliospores ellipsoid, clavate, or cylindrical, 12–14 by 32–48 μ, apex obtuse, base rounded or narrowed to the pedicel, scarcely constricted at the septum; wall thin, 1–1.5 μ, light greenish yellow, thickened at apex, 3–6 μ, smooth; pedicel equaling the spore, concolorous.

Cyperus ferax L. C. Rich. Quito, Ecuador, Aug. 17, 1920, II, III, *908* (type).

This species differs from *P. abrepta* Kern which occurs on the same host in Costa Rica in the larger urediniospores with the markings placed farther apart, and in the absence of bullate covering to the pores in the urediniospores. The name selected refers to the olivaceous color of the teliospores when seen under the microscope.

8. **Puccinia obvoluta** Jackson & Holway, n. sp.

II. Uredinia hypophyllous, scattered or gregarious on yellow spots, elliptic, large, 1–2 mm., tardily naked, cinnamon brown, pulverulent, long covered by the overarching epidermis which usually splits at one side; urediniospores globoid or ellipsoid, 22–24 by 26–30 μ; wall light golden brown, 1.5–2 μ in thickness, finely and sparsely echinulate, the pores 2, slightly superequatorial.

III. Telia hypophyllous, usually surrounding the uredinia, scattered or confluent, 0.5–1 mm. across, tardily naked, somewhat pulverulent, blackish brown, long covered by the epidermis; teliospores somewhat irregularly clavate or cylindrical, 12–16 by 42–60 μ, obtuse or acute at apex, narrowed below, scarcely constricted at septum; wall colorless or slightly tinted golden brown, thin, 1 μ or less, rather abruptly thickened at apex, 3–4 μ, smooth; pedicel half the length of the spore or commonly less, reddish brown.

Cyperus ferax L. C. Rich. Rio de Janeiro, Brazil, Dec. 20, 1921, II, III, *1414* (type); Gavea, Rio de Janeiro, Brazil, Jan. 13, 1922, II, *1475*.

This species, while perhaps related to the preceding, differs markedly in the characters of the urediniospores.

9. **Puccinia nociva** Jackson & Holway, n. sp.

II. Uredinia not seen; urediniospores in the telia ellipsoid, 18–20 by 22–26 μ; wall 1.5–2 μ thick, cinnamon brown, finely but distinctly and moderately echinulate, the pores 2, superequatorial.

III. Telia hypophyllous, abundant, scattered or gregarious or confluent in large or small groups, elliptic, 1–1.5 mm. long, somewhat tardily naked, blackish brown, pulverulent, ruptured epidermis conspicuous; teliospores clavate or pyriform, 16–20 by 32–45 μ, apex rounded, obtuse, or occasionally acute, base narrowed to the pedicel, occasionally rounded, slightly constricted at the septum; wall thin, 1.5–2 μ, chestnut brown, smooth, apex greatly thickened, 6–10 μ; pedicel colorless, half the length of spore, usually shorter.

Cyperus Meyerianus Kunth. Sorata, Bolivia, Apr. 11, 1920, II, III, *504*.

This species is distinguished from all others on *Cyperus* which we have examined by the small urediniospores with superequatorial pores.

10. **Uredo nociviola** Jackson & Holway, n. sp.

II. Uredinia hypophyllous, scattered, oblong or linear, 1–3 mm. in length, tardily naked, spore mass cinnamon brown, long covered by the epidermis which usually opens by one longitudinal fissure; urediniospores ellipsoid or oblong, 15–16 by 18–22 μ; wall 1.5–2 μ, cinnamon brown, very finely and closely verrucose, more strongly so in the upper portion; pores two, superequatorial.

Cyperus distans L. f. São Paulo, Brazil, May 24, 1922, *1877* (type).

Cyperus cayennensis (Lam.) Britton. São Caetano, São Paulo, Brazil, Feb. 22, 1922, *1583a*.

No telia or teliospores could be found though the rust is probably a *Puccinia*. It is distinguishable from *P. nociva* by the smaller spores with much less prominent markings. The second specimen listed was segregated from a collection, the bulk of which is determined as *P. Cyperi* Arth.

11. UREDO KYLLINGIAE P. Henn. Hedwigia **35**: 256. 1896.

Kyllinga brevifolia Rottb. Santo Amaro, São Paulo, Brazil, March 16, 1922, *1638*.

Kyllinga pumila Michx. Quito, Ecuador, Sept. 2, 1920, *959*.

Since no telia have been found either in North or South America, it is felt best to list this form by itself. While the urediniospores resemble those of *P. Cyperi* to some extent, the walls are quite constantly practically colorless and they average smaller in size.

12. PUCCINIA SCLERIAE (Paz.) Arth. Mycologia **9**: 75. 1917.

Rostrupia Scleriae Paz. Hedwigia **31**: 96. 1892.

Aecidium passifloricola P. Henn. Hedwigia **43**: 168. 1904.

Dicaeoma Scleriae Arthur, N. Am. Fl. **7**: 349. 1920.

Scleria sylvestris Poepp. & Kunth. Sumaré, Rio de Janeiro, Brazil, Aug. 25, 1921, II, *1071;* Campo Grande, Rio de Janeiro, Brazil, Sept. 19, 1921, II, III, *1129;* Reserva Florestal, Itatiaya, Brazil, May 14, 1922, II, III, *1853;* Taipas, São Paulo, Brazil, June 10, 1922, II, *1952*.

This very characteristic rust is apparently abundant in Brazil, but has not been collected elsewhere on *Scleria* in South America except on the Island of Trinidad. It is also known from Panama, Cuba, and Porto Rico. In 1918, H. E. Thomas working in Porto Rico conducted cultures which showed that an *Aecidium* on *Passiflora rubra* L. was genetically connected (Phytopathology **8**: 163. 1918). This is considered to be *Aecidium passifloricola*, the type for which was collected in Peru. It should be noted that the rust on *Scleria* has not yet been collected on the west coast of South America. A reexamination of the type of *A. passifloricola* shows, however, no appreciable difference from the aecial material used by Thomas in his cultures. Aecia have been collected on *Passiflora tricuspis* Mast. from Peru; on *P. tuberosa* Jacq. from Trinidad; on *P. rubra* L. from Trinidad, Cuba, Porto Rico, Jamaica; and on *P. biflora* Lam. from Costa Rica.

13. UROMYCES SCLERIAE P. Henn. Hedwigia Beibl. **38**: 67. 1899.

Nigredo Scleriae Arth. Résult. Sci. Congr. Bot. Vienne 344. 1906.

Scleria pratensis Lindl. Reserva Florestal, São Paulo, Brazil, May 14, 1922, II, III, *1849;* Guarujá, São Paulo, Brazil, July 13, 1922, II, III, *2011.*

The type of this species was collected in Southern Brazil by Ule (*2477*). It is also known in South America from Pará at the mouth of the Amazon in Eastern Brazil, Colombia, British Guiana, and Trinidad. In North America it is known only from Porto Rico and Cuba.

14. **Puccinia oblongula** Jackson & Holway, n. sp.

II. Uredinia not seen; urediniospores in the telia broadly ellipsoid, 20–24 by 26–34 μ; wall 1.5–2.5 μ, golden brown, moderately and finely echinulate; pores rather obscure, 2 equatorial.

III. Telia hypophyllous, round or oval, 0.2–0.5 mm. across, tardily naked, chestnut brown, ruptured epidermis conspicuous; teliospores ellipsoid or oblong, 18–24 by 40–70 μ, apex rounded or obtuse, base rounded or narrowed to pedicel, slightly constricted at septum; wall golden or light cinnamon brown, 1–1.5 μ, the apex thickened to 4–7 μ, smooth, germinating at once; pedicel colorless, equaling the spore or shorter.

Rynchospora sp. Quito, Ecuador, Aug. 14, 1920, II, III, *885* (type).

Two other species of *Puccinia* have been described on *Rynchospora*, *P. angustatoides* and *P. rhynchosporicola* Speg. This species differs from both in the character of the teliospores and from the former in the character of the markings and in the position of the pores in the urediniospores.

15. **Uromyces oblectaneus** Jackson & Holway, n. sp.

II. Uredinia amphigenous, chiefly hypophyllous, oval or elliptic, 0.5–1.5 mm. long, early naked, cinnamon brown, ruptured epidermis persistent and conspicuous; urediniospores ellipsoid or obovate, 22–26 by 28–32 μ; wall 2–3 μ in thickness, dark cinnamon brown, sparsely and prominently echinulate; pores 2 or more commonly 3, approximately equatorial.

III. Telia hypophyllous, oval or elliptic, 0.5–2 mm., early naked, blackish brown, ruptured epidermis conspicuous; teliospores irregularly ellipsoid or obovoid, 16–20 by 23–34 μ, base rounded or attenuate, occasionally truncate, apex rounded, obtuse or truncate; wall chestnut brown, 1.5–2 μ in thickness, apex thickened, 4–9 μ, smooth; pedicel equaling the spore, firm, tinted.

Rynchospora exaltata Kunth. Rio de Janeiro, Brazil, Aug. 10, 1921, II, III, *1014;* Sylvestre, Rio de Janeiro, Brazil, Sept. 16, 1921, II, III, *1113* (type); Villa Prudente, São Paulo, Brazil, May 31, 1922, II, III, *1923.*

16. UROMYCES RHYNCOSPORAE Ellis, Jour. Myc. **7**: 274. 1893.

Uromyces rhynchosporicola P. Henn. Hedwigia **35**: 226. 1896.

Nigredo Ryñchosporae Arth. Résult. Sci. Congr. Bot. Vienne 344. 1893.

Rynchospora corymbosa (L.) Britton. Ribeirão Pires, São Paulo, Brazil, March 25, 1922, II, *1681;* Guarujá, São Paulo, Brazil, July 13, 1922, II, *2013.*

Rynchospora scaberrima Boeck. Campos do Jordão, São Paulo, Brazil, Apr. 28, 1922, II, *1790.*

The forms with finely verrucose echinulate urediniospores having two equatorial or slightly superequatorial pores are assigned to this species. *Uromyces rhynchosporicola* P. Henn. is included as a synonym, following Sydow who states that it is only a *Uredo*-form which agrees well with this species. It should be noted, however, that the urediniospores agree also with the correlated *Puccinia angustatoides* R. E. Stone. This species has been reported from South America in the telial stage from Trinidad, on *Rynchospora corymbosa*. All the records of *Uromyces Rhyncosporae* Ellis from South America have consisted of uredinia only. It is therefore entirely possible that part or all of the South American collections may be the uredinia of the *Puccinia*.

SPECIES ON ARACEAE

17. AECIDIUM AROIDEUM Cooke, Grevillea **8**: 71. 1879.

Aecidium Stylochitonis Har. & Pat. Bull. Mus. Hist. Nat. Paris, 201. 1909.

Spathantheum Orbignyanum Schott. Cochabamba, Bolivia, March 10, 1920, *390½*.

Xanthosoma sp. Cochabamba, Bolivia, March 25, 1920, *320*.

The collections listed above are referred to this species with some hesitation. No material has been available for comparison, but since the spore measurements are approximately the same, it has seemed best to assign the collections to this species for the present. The type was collected in Natal, Africa.

SPECIES ON BROMELIACEAE

18. PUCCINIA PITCAIRNIAE Lagerh. Bull. Soc. Myc. Fr. **11**: 214. 1895.

Pitcairnia pungens H.B.K. Quito, Ecuador, Aug. 9, 1920, II, III, *951*.

This collection, made near the type locality, is typical of the species as described by Lagerheim. The urediniospores are large, the walls thick, chestnut brown, sparsely and prominently echinulate and with 2 equatorial pores. Mesospores are abundant, outnumbering the two-celled spores. The only other collection of this species which we have examined was made by Holway at Chapala, Mexico, in 1899 and distributed in Barth. N. Am. Ured. *359* and Fungi Col. *4065*. In this material there are only a very few mesospores and the urediniospores have very thick golden yellow walls. At first sight the two collections would appear to represent different species. The only other rust on this family from South America is *Uredo Nidularii* P. Henn. which is not related.

SPECIES ON COMMELINACEAE

19. **Phakopsora tecta** Jackson & Holway, nov. nom.

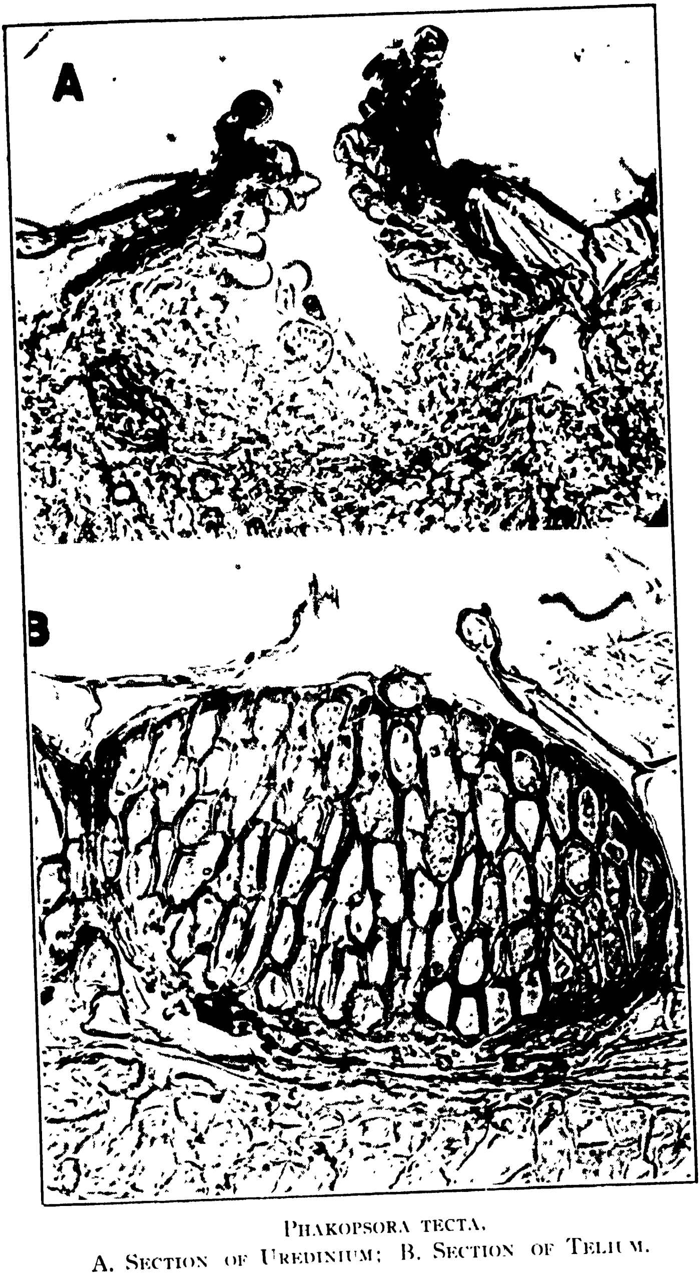
?Uredo Commelyneae Kalchbr. Grevillea **11**: 24. 1882. (Not Speg. 1880.)

II. Uredinia hypophyllous, gregarious in small groups, round or mamillose, 0.1–0.4 mm. across, dark cinnamon brown, long covered by the epidermis, finally opening by a central pore; peridium membranous, apparently formed by the united bases of paraphyses, paraphyses mostly on the inner upper surface of peridium or at the orifice, clavate or capitate, 8–12 μ, broad, the wall colorless, or when at the orifice, cinnamon brown, thickened, at apex 5–10 μ; urediniospores somewhat irregularly ellipsoid, 18–22 by 24–32 μ; wall colorless, thin, 1–1.5 μ, closely and finely verrucose or echinulate-verrucose; the pores obscure.

III. Telia hypophyllous, numerous, subepidermal, distinct, closely scattered about the groups of uredinia, occupying large areas of the leaf, circular in outline, small, long covered by the epidermis, compact, punctiform, blackish brown; in section ellipsoid, 190–250 μ broad by 124–160 μ high, arising from the lower part of the mesophyll apparently in the substomatal cavities, without peridium; teliospores 5–6 in series in center of sorus, irregularly ellipsoid or oblong, 13–16 by 24–34 μ; wall thin, 1–1.5 μ, interior spores colorless or slightly tinted and with irregular extension at apex, spores at outer surface of sorus cinnamon brown, and definitely thickened, at apex 6–10 μ.

Commelina quitensis Benth. Sorata, Bolivia, Apr. 16, 1920, II, III, *536* (type).

This species has long been known in America in the uredinial stage on various species of *Commelina*, being referred to *Uredo Commelyneae* Kalchbr. Specimens of this *Uredo* are in the Arthur herbarium from Porto Rico, St. Thomas, Trinidad, and Argentina. The only other collection of telia of which we have any knowledge is one made by G. Mandon at Sorata, Bolivia, date unknown. This specimen came from the herbarium of Dr. G. Lagerheim. It is probable that *Uredo Commelyneae* Kalchbr. which was collected in Natal, South Africa, is synonymous. The



PHAKOPSORA TECTA.
A. SECTION OF UREDINIUM; B. SECTION OF TELIUM.

portion of the type which we have had available for examination, however, is too meager for comparative study of the sori. The spores are apparently like those of the American material. The name *Uredo Commelyneae* (aberrant spelling for *U. Commelinae*) is not, however, a tenable one as Spegazzini used this name in 1880 for the uredinial stage of *Uromyces Commelinae* Cooke.

20. UROMYCES COMMELINAE Cooke, Trans. Roy. Soc. Edin. **31**: 342. 1888.

Uredo Commelinae Speg. Anal. Soc. Ci. Argent. **9**: 172. 1880.

Uredo Spegazzinii De-Toni, in Sacc. Syll. Fung. **7**: 845. 1888.

Uredo ochracea Diet. Hedwigia **36**: 35. 1897.

Uromyces Spegazzinii Arth. Bull. Torrey Club **37**: 573. 1910.

Nigredo Commelinae Arth. N. Am. Fl. **7**: 237. 1912.

Tradescantia elongata Mey. Tremembé, São Paulo, Brazil, Feb. 28, 1922, II, *1604*.

Undetermined *Commelinaceae*. Gavea, Rio de Janeiro, Brazil, Sept. 7, 1921, II, *1092*.

This species is evidently a common one in South America, particularly in southern Brazil and Argentina. It is worthy of note, however, that no telia have ever been found in any of the South American collections. It is entirely possible, therefore, that the assignment of these uredinial collections to the above species may not prove to be correct.

SPECIES ON JUNCACEAE

21. PUCCINIA OBSCURA Schroet. Pass. Nuovo Giorn. Bot. Ital. **9**: 256. 1877.

Dicaeoma obscurum Kuntze, Rev. Gen. **3**^{3}: 469. 1899.

Juncoides excelsum (Buch.) Kuntze. Sorata, Bolivia, Apr. 19, 1920, II, III, *551;* San Felipe, Prov. Sur Yungas, Bolivia, May 19, 1920, II, III, *619;* May 20, 1920, III, *630*.

22. **Uredo macella** Jackson & Holway, n. sp.

II. Uredinia hypophyllous and caulicolous, scattered or gregarious, oval or elliptic, 0.5–1.5 mm., tardily naked, pulverulent, cinnamon or light chestnut brown, ruptured epidermis conspicuous; urediniospores obovate or irregularly ellipsoid, 19–22 by 28–34 μ; wall 1.5–2 μ, cinnamon brown, finely and moderately echinulate, the pores 2, equatorial or slightly subequatorial.

Juncus Dombeyanus Gay. Panamavida, Chile, Dec. 9, 1919, II, *210* (type).

This species is separable from all others on *Juncus* by the large size of the urediniospores. A comparison with the uredinia of *Puccinia juncophila* Cooke & Massee shows that the spores in our material average considerably larger and with thinner walls.

23. UROMYCES JUNCI (Desmaz.) L. Tul. Ann. Sci. Nat. IV. **2**: 146. 1854.

Puccinia Junci Desmaz. Pl. Crypt. *81*. 1825.
Nigredo Junci Arth. N. Am. Fl. **7**: 238. 1912.

Juncus involucratus Steud. Cochabamba, Bolivia, March 1, 1920, II, *355*.

This is a common species in North America and Europe and has been reported a number of times from South America. In North America the aecia are known to occur on Carduaceae including *Ambrosia*, *Arnica*, *Cirsium*, *Helianthus*, etc. No aecia from South America have been assigned to this species, however.

24. UROMYCES SILPHII (Burrill) Arth. Jour. Myc. **13**: 202. 1907.

Aecidium Compositarum Silphii Burrill; De-Toni, in Sacc. Syll. Fung. **7**: 798. 1888.
Uromyces Junci-tenuis Sydow, Monog. Ured. **2**: 289. 1910.
Nigredo Silphii Arth. N. Am. Fl. **7**: 239. 1912.

Juncus cyperoides La Harpe. Puerto Varas, Lago Llanquihue, Chile, Nov. 27, 1919, II, III, *188*.

Juncus imbricatus La Harpe. Panamavida, Chile, Dec. 9, 1919, II, *206*.

The urediniospores show two superequatorial pores and on this account the specimens are assigned as above. While the species has been cultured only to *Silphium* in North America, there is some field evidence to indicate that other species of Carduaceae are aecial hosts. It should, of course, be recognized that complete knowledge of the life history of the South American forms, together with a careful comparative study of ample material from various localities and on a number of hosts, may result in quite a different assignment of these collections.

An examination of Ule's No. *1254* collected at Tubarão, Sta. Catharina, Brazil, Feb. 1899, on *Juncus dichotomus*, which was recorded by Hennings as *Uromyces Junci* (Hedwigia **35**: 226. 1896), is better referred to the above species as the pores of the urediniospores are superequatorial.

SPECIES ON LILIACEAE

25. **Aecidium Millae** Jackson & Holway, n. sp.

O. Pycnia scattered among the aecia or in a central group, subepidermal, yellowish, globoid or ellipsoid, 80–98 μ in diameter by 96–110 μ high, ostiolar filaments short.

I. Aecia amphigenous, in groups on yellowish spots, 2–8 mm. across; peridium yellowish, firm, margin erose; peridial cells in side view oblong, 19-22 by 26–30 μ, outer wall smooth, 6–8 μ thick, inner wall minutely tuberculate-rugose, 4–5 μ thick, slightly overlapping; aeciospores globoid or ellipsoid, 20–26 by 24–32 μ; wall 1.5–2 μ thick, colorless, closely and strongly verrucose.

Milla Poeppigiana Baker. Termas de Chillan, Chile, Dec. 27, 1919, *249a* (type).

This *Aecidium* was associated with a *Puccinia* on the same host which is referred to *P. Steinmanniae*. The *Aecidium* occurred only on young leaves while the *Puccinia* occurred on mature languishing leaves. We believe that the *Aecidium* is heteroecious and *P. Steinmanniae* is a micro-form.

26. **Puccinia Nothoscordi** Jackson & Holway, n. sp.

I. Aecia few, associated with telia, large, 0.5 mm. across; peridium membranous, erose, yellowish; peridial cells seen only in face view, irregularly polyhedral, 24–26 by 26–32 μ, evidently considerably overlapping, inner wall conspicuously verrucose; aeciospores globoid or broadly ellipsoid; wall thin, colorless, 1–1.5 μ, closely and finely verrucose.

III. Telia amphigenous, gregarious and more or less confluent in groups 5–10 cm. across, tardily naked, pulverulent, blackish, ruptured epidermis conspicuous; *teliospores ellipsoid oblong or* pyriform, 18–22 by 34–44 μ, *rounded above, rounded or somewhat* narrowed below, strongly or not constricted at septum; wall uniformly 1.5–2.5 μ thick, cinnamon or chestnut brown, smooth; pedicel short, colorless.

Nothoscordum sp. Cuzco, Peru, June 29, 1920, I, III, *741* (type).

Only a very few aecial cups were seen associated with the telia. These occurred at the margin, not in the center of the group of sori, and were very old, admitting of only incomplete description.

The teliospores are quite irregular and variable; some rather opaque spores, conspicuously constricted, are present, others are lighter in color and with scarcely any constriction.

This species is either a regular opsis-form or one of those micro-forms which occasionally show the presence of aecia as in *P. Cryptotaeniae* (= *P. microica*).

27. PUCCINIA PASITHEAE Diet. & Neg. Bot. Jahrb. **24**: 156. 1897.

Aecidium Pasitheae Diet. & Neg. Bot. Jahrb. **22**: 356. 1896.

Pasithea coerulea Don. Papudo, Chile, Sept. 17, 1919, II, III, *34;* San José de Maipo, Chile, Oct. 8, 1919, II, III, *93;* Panamavida, Chile, Dec. 17, 1919, III, *243;* Baños de Cauquenes, Rancagua, Chile, Jan. 13, 1920, III, *293.*

While this is evidently a common species in this region, it is otherwise known only from the type collections.

28. PUCCINIA STEINMANNIAE Diet. & Neg. Bot. Jahrb. **24**: 156. 1897.

Milla Poeppigiana Baker. Termas de Chillan, Chile, Dec. 27, 1919, III, *249.*

This collection consisted of aecia and telia. The telia are fully mature on old but not overwintered leaves of the host. The aecia are on young leaves. It is considered probable that the aecia are those of some heteroecious rust and are hence described separately as *Aecidium Millae* n. sp. The telia agree well with the above species and are so assigned. The aspect is that of a micro-form.

29. UROMYCES DUSENII Diet. & Neg. Bot. Jahrb. **27**: 1. 1899.

Gilliesia graminea Lindl. Constitution, Chile, Oct. 19, 1919, I, III, *130*.

Ornithogalum biflorum D. Don, (*Scilla chloroleuca* Kunth). Viña del Mar, Chile, Sept. 5, 1919, *2*.

The only other collection of this species of which we have any record is that of the type made by P. Dusen near Talcomahuida, Chile, on *Gilliesia monophylla* Reiche, which we have not seen. The species is evidently an opsis-form. In our specimen on *Gilliesia* the teliospores are considerably smaller than given in the original description, measuring 18–22 by 26–40 μ. This measurement more nearly corresponds to that given by Sydow as 18–25 by 25–42 μ (Monog. Ured. 1: 273).

We have included with this species the collection on *Ornithogalum*. The sorus characters correspond and the markings of the teliospore wall are identical in character. The teliospores are, however, somewhat smaller and broader in proportion to the length, often nearly globoid, measuring 20–26 by 24–30 μ.

We have not seen the type of *Uromyces Solariae* Diet. on *Solaria miersioides* but from the description we would suggest the possibility that it is synonymous.

30. UROMYCES TRITELEIAE Diet. & Neg. Bot. Jahrb. **24**: 153. 1897.

Leucocoryne alliacea Lindl. Constitution, Chile, Oct. 18, 1919, I, III, *128*.

A comparison of this collection with the type of *U. Triteleiae* shows substantial agreement and it is so assigned with considerable confidence.

SPECIES ON SMILACACEAE

31. **Sphenospora yurimaguasensis** (P. Henn.) n. comb.

Uredo yurimaguasensis P. Henn. Hedwigia **43**: 164. 1904.

Sphenospora smilacina Sydow, Ann. Myc. **23**: 318. 1925.

Smilax domingensis Willd. Taquara, Rio de Janeiro, Brazil, Aug. 30, 1921, II, *1085*.

Smilax sp. San Francisco, Nictheroy, Rio de Janeiro, Brazil, Sept. 23, 1921, II, *1144*; Cantareira, São Paulo, Brazil, May 30, 1922, II, iii, *1916*; São João, São Paulo, Brazil, July 2, 1922, II, *1988*.

This combination is proposed for the *Sphenospora* which occurs on *Smilax*. This was first recognized by Arthur (Mycologia **10**: 121. 1918, and Am. Jour. Bot. **5**: 434. 1918) from Costa Rica and Guatemala, who assigned it to *Sphenospora pallida* (Wint.) Dietel.

The *Smilax* form is distinct and is now known to occur in Costa Rica, Guatemala, Trinidad, Peru and Brazil. The type of *Uredo yurimaguasensis* P. Henn. has not been seen but the description fits the uredinia of this rust very accurately except that I find only occasional urediniospores with thickened apices.

A full description of this and the preceding species is reserved for another place.

The report of *Puccinia Smilacis* Schw. (Arthur, Bot. Gaz. **73**: 66. 1922) from Trinidad is based on an error in identification. The collection which consists of uredinia only agrees with the species under discussion. It is possible that the other records of *Puccinia Smilacis* Schw. (Pazschke, Hedwigia **31**: 96. 1892, and Sydow, Ann. Myc. **5**: 355. 1907) also belong here as both collections consist of uredinia only. If this is true, then *P. Smilacis* Schw. may not occur in South America.

SPECIES ON AMARYLLIDACEAE

32. AECIDIUM ALSTROEMERIAE Diet. & Neg. Bot. Jahrb. **22**: 355. 1896.

Alstroemeria Pelegrina L. Papudo, Chile, Sept. 19, 1919, *53*.

Alstroemeria sp. San José de Maipo, Chile, Oct. 8, 1919, *95;* Constitution, Chile, Oct. 15, 1919, *117*.

Tecophilaea violaeflora Bert. Olmue, Chile, Sept. 11, 1919, *20;* Papudo, Chile, Sept. 19, 1919, *47*.

Though occurring in the same region with *Puccinia Alstroemeria* Syd. this *Aecidium* is probably heteroecious. The type collection was made on *Alstroemeria Ligtu* L. at Conception, Chile, by F. W. Neger. It is probable that the collection number *1375* of Bertero made at Valparaiso, Chile, on *Alstroemeria* and reported by Montagne (in Gay, Historia de Chile, **8**: 37. 1852) as *Aecidium Allii* belongs here.

33. **Aecidium tenebrosum** Jackson & Holway, n. sp.

O. Pycnia amphigenous, few, scattered or in a small group opposite or among the aecia, flattened globoid, 100–130 μ high by 130–160 μ broad; ostiolar filaments forming a short column.

I. Aecia hypophyllous, occurring singly or in groups of 2–20 on yellowish spots, large, 350–370 μ in diameter; peridium yellowish, firm, overarched, opening irregularly; peridial cells oblong in side view, 12–16 by 24–28 μ, outer wall transversely striate, 3–5 μ in thickness, inner wall 2–3 μ, finely verrucose, abutted or slightly overlapping; aeciospores globoid or ellipsoid, 23–26 by 26–32 μ; wall cinnamon brown, 1.5–2.5 μ thick, finely but prominently verrucose, the pores evident, 8–10, scattered.

Alstroemeria sp. Papudo, Chile, Sept. 18, 1919, *42* (type); Zapallar, Chile, Sept. 22, 1919, *64*.

This species is distinguished from *A. Alstroemeriae* by the larger spores having thick, evidently colored walls, with plainly visible pores.

34. PUCCINIA ALSTROEMERIAE Syd. Monog. Ured. **1**: 603. 1903.

Alstroemeria revoluta R. & P. Termas de Chillan, Chile, Dec. 31, 1919, III, *263*.

Alstroemeria sp. Maipo Valley, Santiago, Chile, Oct. 2, 1919, III, *77;* San José de Maipo, Chile, Oct. 4, 1919, III, *87;* Oct. 6, 1919, *90;* Oct. 8, 1919, III, *94*.

A very distinct species otherwise known only from the type collection made on *A. revoluta* at Cordillera de St. Fernando, Chile. Collection No. *94* bears some *Aecidium Alstroemeriae* Diet. & Neg. on the same leaves. Field observations made by Prof. Holway, however, indicate that there is no genetic connection. *P. Alstroemeriae* is apparently a micro-form while *Aecidium Alstroemeriae* is presumably heteroecious.

35. PUCCINIA BOMAREAE P. Henn. Hedwigia **35**: 242. 1896.

Uredo Bomareae Lagerh. in Pat. & Lagerh. Bull. Soc. Myc. France **11**: 215. 1895.

Bomarea Caldasiana (H.B.K.) Herb. Quito, Ecuador, Aug. 14, 1920, II, *887*.

Bomarea ovata (Cav.) Mirb. São João, São Paulo, Brazil, March 19, 1922, III, *1654*.

Bomarea sp. Sorata, Bolivia, Apr. 26, 1920, II, III, *574*.

36. PUCCINIA HABRANTHI Diet. & Neg. Bot. Jahrb. **24**: 157. 1897.

Hippeastrum pratense (Poepp.) Baker. Papudo, Chile, Sept. 17, 1919, I, III, *35;* Temuco, Chile, Nov. 3, 1919, III, *163.*
Hippeastrum bicolor (R. & P.) Baker. Constitution, Chile, Oct. 15, 1919, III, *115.*

Uredinia were not seen but mammoth urediniospores, 32–38 by 48–56 μ, with colorless walls were noticed in one collection. In this species the wall of the teliospore is finely and closely verrucose, making it easy to distinguish this from *P. Reichei* on which the markings are coarsely tuberculate. The type collection was made on *Habranthus andicola* Herb. and in the portion we have examined the markings of the teliospores are very fine and inconspicuous, while on *Hippeastrum pratense* the markings are somewhat more prominent and even more so on *Hippeastrum bicolor.*

37. PUCCINIA PALLOR Arth. & Holw. Mycologia **10**: 129. 1918.

Eriosporangium Pallor Sydow, Ann. Myc. **20**: 122. 1922.
Dicaeoma Pallor Arth. N. Am. Fl. **7**: 379. 1920.
Bomarea sp. San Felipe, Sur Yungas, Bolivia, May 20, 1920, II, III, *629.*

This species has waxy telia with colorless spores which germinate at once, and has been reported previously only from Guatemala and Costa Rica.

38. PUCCINIA REICHEI Diet. & Neg. Bot. Jahrb. **24**: 157. 1897.

Hippeastrum chilense (R. & P.) Baker. Termas de Chillan, Chile, Dec. 3, 1919, I, III, *265.*
Hippeastrum pratense (Poepp.) Baker. Papudo, Chile, Sept. 18, 1919, I, III, *37.*

No authentic collection of this species has been available but the specimens fit the description admirably and there can be little doubt that they are correctly assigned. The first collection listed is on the type host (as *Habranthus chilensis* Herb.) and from the same general region. The species is evidently an opsis-form, aecia and telia being abundant in both collections.

39. UREDO HYPOXIDIS (Bres.) P. Henn. Hedwigia Beibl. **40**: 173. 1901.

Doassansia Hypoxidis Bres. in Rab.-Paz. Fungi Eur. *4201.* 1901.

Uredo globulosa Arth. Mycologia **8**: 22. 1916.

Hypoxis decumbens L. Sumaré, Rio de Janeiro, Brazil, Aug. 25, 1921, *1070.*

Hypoxis sp. Taipas, São Paulo, Brazil, June 10, 1922, *1951.*

There seems to be no sufficient reason for considering this *Uredo* a synonym of *Uromyces affinis* Wint. While Sydow (Monog. Ured. **4**: 515. 1924) gives the pores as 6–8 scattered, we could not make them out with certainty. The species is abundant in South America, Central America and the West Indies.

40. UROMYCES ALSTROEMERIAE (Diet.) P. Henn. Hedwigia Beibl. **38**: 67. 1899.

Uredo Alstroemeriae Diet. Hedwigia **36**: 35. 1897.

Alstroemeria inodora Herb. Reserva Florestal, São Paulo, Brazil, May 11, 1922, II, III, *1843.*

Alstroemeria Isabellana Herb. Itatiaya, São Paulo, Brazil, May 18, 1922, II, III, *1862.*

SPECIES ON DIOSCOREACEAE

41. SPHENOSPORA PALLIDA (Wint.) Dietel, E. & P. Nat. Pfl. **1****: 70. 1897.

Diorchidium pallidum Wint. Grevillea **15**: 86. 1887.

Uredo Dioscoreae P. Henn. Hedwigia **35**: 255. 1896.

Puccinia Sphenospora Sydow, Monog. Ured. **1**: 838. 1904.

Dioscorea grandiflora Mart. Paineiras, Rio de Janeiro, Brazil, Aug. 14, 1921, II, iii, *1037;* Gavea, Rio de Janeiro, Brazil, Sept. 8, 1921, II, iii, *1096.*

Dioscorea sp. Nictheroy, Rio de Janeiro, Brazil, Aug. 18, 1921, II, iii, *1053.*

The genus *Sphenospora* was founded by Dietel on a collection made by E. Ule near San Francisco, Brazil (No. *143*). The rust was first described by G. Winter (Grevillea **15**: 86. 1887, and

Hedwigia **26**: 117. 1887) as *Diorchidium pallidum*. It was recorded as occurring on the leaves of some sort of climbing plant. Dietel in his first discussion of the rust (Ber. Deutsch. Bot. Ges. **10**: 62. 1892) records the host as *Dioscorea*. Later in connection with the establishment of the genus *Sphenospora* he does not mention *Dioscorea*. The Sydows (Monog. Ured. **1**: 838. 1904) in connection with their redescription of the rust under the name *Puccinia sphenospora* nov. nom., based on the original collection, repeat Winter's original statement with reference to host. Later they record (Ann. Myc. **14**: 67. 1916) *Sphenospora pallida* (Wint.) Diet. from the same general region on *Dioscorea trifida* L. (E. Ule *3510*), but express doubt that the original collection on which the name was based is on *Dioscorea* and note certain differences in the size of the teliospores in the two collections.

In addition to the collections listed above, the writer has recently received for study three other collections of *Sphenospora* on *Dioscorea* from Costa Rica and Panama.

In 1918, Arthur recorded (Mycologia **10**: 121. 1918) *Sphenospora pallida* on *Smilax* from Costa Rica and Guatemala. I have specimens also from Trinidad and Brazil.

The forms on *Dioscorea* and *Smilax* represent distinct species and the question arises as to the proper assignment of the original name. At the present writing this cannot be done with absolute certainty but the small size and globoid character of the urediniospores as described by Dietel and Sydow, together with the character of the telia and teliospores as described by Winter, Dietel and Sydow, indicates that the form on *Dioscorea* was the one first described.

The main point of difference in the two forms which I have noted is in the pores of the urediniospores. In the form on *Dioscorea* there are four or more irregularly equatorial pores, while in the form on *Smilax* there are two equatorial pores. There are important differences also in the teliospores.

There can be little doubt that *Uredo Dioscoreae* P. Henn. is the same. The type locality is in the same general region as that in which the above collections were made and the urediniospores agree in shape, size and pore characters. The host is the same. Our material consists primarily of uredinia but there are a few telia or teliospores in the uredinia, in all three collections.

Whether all the collections which have been referred to *Uredo Dioscoreae*, especially those of the West Indies, belong here is an open question.

SPECIES ON IRIDACEAE

42. PUCCINIA ANGULATA Diet. & Neg. Bot. Jahrb. **24**: 156. 1897.

Sisyrinchium junciforme Poepp. Papudo, Chile, Sept. 18, 1919, II, III, *46*.

Sisyrinchium pedunculatum Hook. Zapallar, Chile, Sept. 22, 1919, II, III, *60;* Zapallar, Chile, Jan. 31, 1920, II, III, *304*.

Sisyrinchium sp. San José de Maipo, Chile, Oct. 6, 1919, II, III, *89;* Panamavida, Chile, Dec. 15, 1919, II, III, *233;* Pichilemu, Chile, Oct. 12, 1919, II, III, *110*.

This is a very distinct species in which the telia are long covered by the epidermis and is not to be confused with *P. straminea* in which the telia are open. This species is also known from Mexico.

43. **Puccinia Cypellae** Jackson & Holway, n. sp.

III. Telia amphigenous, scattered singly or in groups 1–2 mm. in length on yellowish spots, oval, 0.5–2 mm. long, tardily naked, somewhat pulverulent, blackish brown, ruptured epidermis conspicuous; teliospores ellipsoid or oblong, often irregular, 18–22 by 30–38 μ, rounded above, rounded or truncate below, slightly constricted at the septum; wall uniformly 1.5–2 μ thick or occasionally slightly thickened to 3 μ over apical pore, finely and faintly verrucose; pedicel colorless or slightly tinted, firm, short, broad at point of attachment to 10 μ.

Cypella sp. La Paz, Bolivia, March 27, 1920, III, *472* (type).

A very distinct species, differing from any others on Iridaceae in the roughened spores.

44. PUCCINIA STRAMINEA Diet. Hedwigia **38**: 249. 1899.

Sisyrinchium sp. Therezopolis, Rio de Janeiro, Brazil, Oct. 6, 1921, II, III, *1193*.

This collection agrees well with the type. We find in the type and in our own collection spores with apices thickened to 10 μ.

It seems entirely possible that this species is not different from *P. Sisyrinchii* Mont.

45. **Uredo tenebrosa** Jackson & Holway, n. sp.

II. Uredinia amphigenous, scattered or occasionally confluent lengthwise, intercostal, on purplish spots, elliptic or linear, 0.5–1.5 mm. long, tardily naked, chestnut brown, pulverulent, long covered by the epidermis which ruptures along one side; urediniospores obovoid, 20–24 by 24–30 μ; wall cinnamon to chestnut brown, thick, 2.5–3.5 μ, finely and rather sparsely echinulate; pores 3 or 4, equatorial.

Undetermined *Iridaceae*, Curityba, Paraná, Brazil, June 20, 1922, II, *1976*.

46. **Uromyces Bunsteri** (Neger) n. comb.

Aecidium Bunsteri Neger, Anal. Univ. Chile **93**: 778. 1896.
Uromyces Sisyrinchii Mont. in Diet. & Neg. Bot. Jahrb. **22**: 349. 1896. (Description only.)
Uromyces probus Arth. Bull. Torrey Club **38**: 376. 1911.
Uromyces sisyrinchiicola Speg. Bol. Acad. Nat. Cienc. Cordoba **27**: 352. 1924.
Nigredo proba Arth. N. Am. Fl. **7**: 243. 1912.

Sisyrinchium cuspidatum Poepp. Panamavida, Chile, Dec. 15, 1919, II, III, *236;* Termas de Chillan, Chile, Jan. 4, 1920, I, III, *272*.

Sisyrinchium graminifolium Lindl. Papudo, Chile, Sept. 18, 1919, II, III, *44;* Constitution, Chile, Oct. 15, 1919, II, III, *113*.

Sisyrinchium sp. Panamavida, Chile, Dec. 17, 1919, II, III, *242*.

It is quite evident that this *Uromyces* is common in Chile. The telial stage was first described by Dietel and Neger on *S. graminifolium*, who, however, used the old name *Uromyces Sisyrinchii* Mont. They found on their specimens both a *Uromyces* and the uredo and telia of *Puccinia Sisyrinchii* Mont. and interpret Montagne's description of *Uromyces Sisyrinchii* to have been based on a similar mixture and that Montagne described the uredinia of the *Uromyces* as *Uromyces Sisyrinchii* and not the uredinia of the *Puccinia*. It does not appear from their account that they examined the type material. Hariot (Bull. Soc. Myc. Fr. **7**: 198, 199. 1891) and Sydow (Monog. Ured. **2**: 601. 1903), however, having examined the original collections involved, agree that *Uromyces Sisyrinchii* Mont. is based on the uredinia of the *Puccinia*. In any case it seems best to accept the decision of Hariot and Sydow.

The species was next described by Arthur as *Uromyces probus* from material collected in the state of Washington. This is now known also from Utah.

Spegazzini has recently described what appears to be the same species from southern Patagonia on *S. iridifolia*. A collection made by Dr. R. Thaxter at Punta Arenas, Magellan Straits, near where Spegazzini's collection was obtained is in the Arthur Herbarium and agrees with the Holway material.

Aecidium Bunsteri Neg. was described on *S. andinum* Phil. from Chile. Neger writes (translating freely): ". . . in *Aecidium Bunsteri* many peridia are united into an extended series. This arrangement is very noticeable as the aecia begin to appear. The leaves are traversed by parallel, fairly evident veins. In these veins of the leaves the aecia are formed." While we have not seen the type, this arrangement, as well as the microscopic characters so far as described, fits our material so admirably that we venture to make the above combination. This arrangement of the aecia is also noticeable in *Uromyces probus* and is mentioned by Spegazzini in his description of *U. sisyrinchiicola*.

SPECIES ON CANNACEAE

47. PUCCINIA CANNAE (Wint.) P. Henn. Hedwigia **41**: 105. 1902.

Uredo Cannae Wint. Hedwigia **23**: 172. 1884.

Puccinia Thaliae Diet. Hedwigia **38**: 250. 1899.

Dicaeoma (?) *Cannae* Arth. N. Am. Fl. **7**: 380. 1920.

Canna sp. Nictheroy, Rio de Janeiro, Brazil, Dec. 27, 1921, II, *1427*.

Apparently a very common species in Brazil, having been reported a number of times on various species of *Canna*. It is also known in South America from British Guiana, Trinidad, and Colombia, and is common in the West Indies.

Puccinia Thaliae Diet. on *Thalia dealbata* Fraser in the Marantaceae, the type of which was collected at Rio de Janeiro, is included on the authority of Arthur (N. Am. Fl. **7**: 380. 1920) who also reports it on *Maranta arundinacea* L. from Trinidad.

SPECIES ON ORCHIDACEAE

48. UREDO LYNCHII Plowr. Monog. Br. Ured. Ust. 259. 1889.

Trichobasis Lynchii Berk. Gard. Chr. II. **8**: 242. 1877.

Spiranthes nitida Cogn. Therezopolis, Rio de Janeiro, Brazil, Oct. 11, 1921, II, *1214*.

This collection is referred to this species with some doubt. The spores measure 18–22 by 26–28 μ, the wall is 2.5–3.5 μ thick, rather sparsely but very prominently echinulate. The orchid rusts are difficult to identify with any certainty. There are probably many more names than species.

49. UREDO sp.

On terrestrial orchid, Nictheroy, Rio de Janeiro, Brazil, Sept. 23, 1921, *1150*.

The sori are minute, in groups, usually several around a large central sorus, on discolored spots 1–3 mm. across; spores 18–22 by 22–28 μ, the wall golden brown, 2.5–3 μ thick, sparsely and finely echinulate verrucose, pores evident, 3, equatorial.

The host has thin, elliptic leaves 5–6 inches in length and half as broad.

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NEW SPECIES OF FUNGI FROM MISSISSIPPI

L. E. Miles

Mississippi is practically untouched territory as far as the mycologist is concerned. It is true that two of the industrious older workers in this field, S. M. Tracy and F. S. Earle, did considerable collecting and described a number of new species from this state some years ago, but when the extent and varied nature of the vegetation is considered, it must be realized that the surface has scarcely been touched.

The thirteen new species here described represent specimens picked up at random in the course of casual collections made at intervals, as other duties would permit, during a two-year stay in the state. Very few of the more desirable collecting grounds were even touched, but enough was seen to lead one to believe that an abundant harvest would be reaped by one to whom the opportunity should be presented to spend some time in their reaches.

1. **Asterella Myricae** sp. nov.

Spots none; mycelium very scant or obsolete, when present black brown, delicate; perithecia hypophyllous, gregarious, suborbicular to elliptical, depressed hemispherical, astomous, black, fibrillose at the edges, 300–400 μ in diameter, aparaphysate; asci numerous, broadly ovate to elliptical, sessile, 28–30 × 15–18 μ; spores inordinate to subtristichous, ovate-oblong, 1-septate in the middle, slightly constricted, lower cell slightly heavier, obtuse at each end, hyaline, 12–15 × 4.5 μ.

On living leaves of *Myrica carolinensis*, Vancleave, Mississippi, *501* (type).

This species occurs on the lower sides of the leaf exclusively and superficially has the appearance of a *Leptothyrium* or fly-speck fungus. The mycelium may be entirely absent, and when present is so scant as to be invisible to the unaided eye. The perithecia are usually rather remotely grouped but sometimes occur singly. The fungus was found on the same leaves with *Mycosphaerella Myricae* described below.

2. **Dimerium nigrosporum** sp. nov.

Epiphyllous; mycelium light fuscous, parasitizing that of some sterile *Meliola* colony, branching but little, somewhat flexuous, septate, 3–5 μ in diameter; perithecia numerous, superficial, sphaeroid, delicately membranous, black, parenchymatic, astomous, but tearing open in a stellate manner at the top with the lobes folding back, 180–200 μ in diameter; asci 3–5 in a perithecium, globose, heavily tunicated, strongly thickened at the apex, briefly subpedicellate at the base, 8-spored, 60–65 μ in diameter, paraphysate; paraphyses numerous, flexuous, hyaline; spores conglobate, oblong or oblong-ellipsoid, rounded at each end, in the middle 1-septate, strongly constricted, in the beginning dilute olivaceous, at length very dark fuscous to black, 40–45 × 18–20 μ.

On the sterile mycelium of some species of *Meliola* on leaves of *Ilex coriacea*, Poplarville, Mississippi, *512* (type).

The colonies of *Meliola* vary considerably in size, being from two millimeters in diameter to indefinite patches which cover practically the entire upper surface of the leaf. They are black and crustose with indefinite fibrillose edges. The perithecia of the *Dimerium* are scattered thickly over the entire surface of the older ones. All stages of spore maturity as indicated by colors varying from almost hyaline to an intense black are sometimes found in a single perithecium, and occasionally even in the same ascus. In no case was the *Meliola* observed to be fruiting.

3. **Mycosphaerella Leucothoës** sp. nov.

Spots amphigenous, circular, definite, fuscous to gray in color, girded by a narrow, raised, dark brown line, 2–8 mm. in diameter, often three or more confluent when the raised border disappears within the large, rather irregular spot produced, but remains about it. Perithecia immersed, erumpent, epiphyllous, black, globose, 125–140 μ in diameter, concentrically arranged about a small, sterile, darker colored, circular area in the center of the spot, aparaphysate, with a small ostiole; asci clavate, sessile, usually curved, thin-walled, not thickened at the apex, 67–75 × 15 μ; spores monostichous, obliquely arranged, oblong to oblong-ovate, hyaline, very unequally septate, 15–17 × 5–6 μ, lower cell 3.5 × 4 μ.

On persistent but still living leaves of *Leucothoë axillaris*, Poplarville, Mississippi, *447* (type).

Differs from *Sphaerella Andromedae* Tracy & Earle in all particulars.

4. **Mycosphaerella Myricae** sp. nov.

Spots amphigenous, various in size and shape, occurring most frequently at the edge of the leaf, 5 mm. to 2 or more centimeters in diameter, brown to red brown in color, bordered by a very narrow purplish brown line, with quite frequently a narrow cinereous band inside; perithecia epiphyllous, minute, numerous, immersed, erumpent, black, 75 μ in diameter, aparaphysate, globose; asci clavate to ovate lanceolate, sessile, 48–58 × 10–12 μ; spores subdistichous, cylindrical, septate in the middle, not constricted, obtuse at each end, upper locule slightly heavier, 16–20 × 3–3.5 μ, hyaline.

On leaves of *Myrica carolinensis*, Vancleave, Mississippi, *499* (type), *502*.

Differs from *Mycosphaerella pardolata* Cooke & Ellis in the much larger spores.

5. **Phyllachora scleriicola** sp. nov.

Spots none, but the occupied portions of the leaf becoming paler; stromata usually epiphyllous, innate, very numerous, oblong or elliptical, 0.5–1 mm. long, 0.2–0.5 mm. wide, encrusted, jet black, somewhat seriately disposed; locules numerous, subglobose or angulate from mutual crowding; asci cylindric to cylindric-clavate, briefly and usually obliquely pedicillate, 100–110 × 14–17 μ, 8-spored; paraphyses numerous, filiform; spores ellipsoid, usually transversely or obliquely monostichous, continuous, hyaline, obscurely 1-guttulate, contents granular, 12–14 × 6–7 μ.

On living leaves of *Scleria triglomerata*, Lucedale, Mississippi, *457* (type).

Differs from *Phyllachora Scleriae* Rehm in its larger asci, the shape of the spores, and the fact that the locules are never solitary in the stroma; from *Phyllachora graminis* (Pers.) Fuckel in its larger asci and spores.

6. **Scolecodothis pinicola** sp. nov.

Stromata on both sides of the needles, not in spots, but irregularly scattered, black, glistening, elliptical, convex, 0.7–1 mm. long, 0.3–0.5 mm. wide, between the epidermis and palisade tissue; clypeate crust black, inclosing the epidermal cells, 15–18 μ thick, with a thin streak or split extending throughout its length, through which dehiscence occurs; locule single, large, occupying the entire inner space, 280–300 μ wide, 130 μ high, sitting on a thin, hyaline hypothecium; asci cylindrical, straight, sessile, abruptly acute at the apex, 80–95 × 12–14 μ, eight-spored, paraphysate; paraphyses numerous, filiform, briefly arched at the tips, 100–125 μ long; spores filiform, parallel, straight or slightly bent at the apex, undivided, 75–85 × 2 μ, hyaline.

On fallen needles of *Pinus taeda*, Starkville, Mississippi, *530* (type).

The stroma of this fungus is *Phyllachora*-like in appearance. The position between the palisade tissue and the epidermis, the filiform spores and presence of paraphyses place it in the genus *Scolecodothis*, established by Thiessen and Sydow in 1915. The species is locally abundant in the region where it was collected.

7. **Phyllosticta Ceanothi** sp. nov.

Spots amphigenous, suborbicular, definite, small, 1–2 mm. in diameter, red brown, limited by a narrow, dark purple-brown line, rarely confluent; pycnidia epiphyllous, scattered, globose, semi-immersed, black, 90–100 μ in diameter, with a small ostiole; spores globose to broadly elliptical or occasionally subpyriform, 6–8 μ wide, granulose, hyaline.

On living leaves of *Ceanothus americana*, Columbia, Mississippi, *458* (type).

The small dark red-brown spots produced by this fungus often occupy a considerable portion of the leaf surface, yet they rarely become confluent. They are invariably paler, though quite distinct on the lower side of the leaf. In the locality where collected the spot was very abundant.

8. **Phyllosticta Rhynchosiae** sp. nov.

Spots amphigenous, small, suborbicular or angulose, 1–2 mm. in diameter, rarely confluent, fuscous brown when young, becoming darker with age, and the center becoming cinereous, bordered by a narrow purple brown line; pycnidia epiphyllous, fuscous brown, globose, delicate in texture, barely perforating the epidermis with a small ostiole, 85–95 μ in diameter; spores globose to broadly ovate, 7–8 μ in width, hyaline.

On living leaves of *Rhynchosia erecta*, Columbia, Mississippi, *459* (type).

9. **Septoria Bumeliae** sp. nov.

Spots amphigenous, subcircular, 2–5 mm. in diameter, at first roseate in color, later becoming grayish white, often confluent, when they become irregular and angulose in outline, bounded by a very narrow, slightly raised, purple to black line, the thin translucent portions within which have a tendency to fall out in the old spots, giving a shot-hole effect; pycnidia epiphyllous, numerous, black, distinct against the white background, 80–100 μ in diameter, globose, rather broadly ostiolate; spores slender, curved or flexuous, pluriguttulate, in maturity becoming 4–6-septate, 50–70 × 2–2.5 μ, hyaline.

On living leaves of *Bumelia lycioides*, Lucedale, Mississippi, *483* (type), Ocean Springs, *722*, Biloxi, *763*.

The spots resemble very much those of *Phyllosticta Bumeliae* Underw. & Earle on the same host, but differ in their smaller size, the roseate color of the young spots, and the smaller number of pycnidia. The thin, translucent, rosy to white spots are usually quite numerous on the infected trees. The narrow, dark purple to black border is very distinct and beyond it there is often a rather broad halo which shades off into the normal leaf tissue. The black pycnidia which stand out so sharply against the thin white background are quite visible on the under side of the leaf, though they occur on the upper side only.

10. **Septoria Valerianellae** sp. nov.

Spots amphigenous, small, circular to elliptical, 1–3 mm. in diameter, light fuscous, becoming pale and dried out, surrounded by a narrow, indefinite, slightly darker line; pycnidia amphigenous, usually epiphyllous, immersed or erumpent, with a minute ostiole, black, globose, 70–80 μ in diameter; spores filiform-bacillar, straight or somewhat flexuous, continuous or obscurely 1–2-septate, 28–33 μ in length, hyaline.

On living leaves of *Valerianella radiata*, A. & M. College, Mississippi, *509* (type), *559*.

This fungus causes the affected plants to become paler in color due to a yellowing of the affected leaves beyond the spots, and is, therefore, readily observed in the field. Our species differs from *Septoria Valerianae* Sacc. & Fautr. described on *Valeriana dioica* in France, in its much longer and differently shaped spores.

11. **Monochaetia Camelliae** sp. nov.

Acervuli punctiform, gregarious, smoky black, subcutaneous, 300–400 μ in diameter, rupturing the cutin irregularly; conidia 4-septate, fusoid, pointed at each end, not constricted, 18–20

× 4–4.5 μ, interior loculi fuscous olivaceous, basal locule usually dilutely colored, apical locule hyaline and terminated by a single, stipitate, filiform hyaline seta, straight or bent at a right angle near its point of union with the spore, 12–14 μ long.

On leaves of *Camellia japonica*, Columbus, Mississippi, *460* (type).

12. **Cercospora Xyridis** sp. nov.

Spots amphigenous, oval, 2–4 mm. long, brown, margin purple brown; hyphae amphigenous, mostly hypophyllous, fasciculate, 2–6 in each group, erect rigid, nodulose toward the apex, pruinose in color, more dilute toward the top, 1–3-septate, 100–130 μ long; conidia hyaline, 4–5-septate, subcylindraceous or gradually attenuate to the apex, 50–60 × 3 μ.

On living leaves of *Xyris elata*, Wiggins, Mississippi, *455* (type).

The leaves of plants affected by this fungus often become browned throughout the occupied area, in which case the outline of the spots becomes indistinct.

13. **Volutella caricicola** sp. nov.

Sporodochia numerous, amphigenous, sessile, applanate, at first cinereous, becoming dark olivaceous to almost black, 75–100 μ in diameter, occupying the entire areas of dead leaves; setae numerous, erect, rigid, gradually tapering from the base, arranged to form a complete border about the sporodochium, dark pruinose-violaceous, scarcely septate, becoming lighter in color toward the apex, 50–100 μ long; conidiophores simple, cylindrical, continuous; conidia falcate to fusiform, curved at apex, acute at each end, 20–28 × 5–5.5 μ, hyaline.

On dead portions of leaves of *Carex cherokeensis*, A. & M. College, Mississippi, *463* (type).

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NOTES ON TESTICULARIA CYPERI

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(With Plate 20 and 1 Text Figure)

According to the published literature, the smut, *Testicularia Cyperi* Klotzsch, is of rather rare occurrence. Clinton[1] lists but a single collection in North America, this having been made at Wading River, New York. It is doubtful if many more collections have found their way into herbaria.

In southern Louisiana this smut is not uncommon. During the past few years it has been collected a number of times at Baton Rouge and sometimes has been seen in considerable abundance. Probably if a systematic search were made it would be found to be quite common. Specimens from Louisiana were first determined by H. S. Jackson of Purdue University, the material being sent to him at his request. He stated also that he had seen specimens from Texas.

The sori of *Testicularia Cyperi* take the place of the developing ovules of the sedge, *Rynchospora corniculata* (Plate 20, Fig. 1). They are usually rather scattering, ordinarily about one to three and rarely more than four or five on a single plant. As all the other seed on the plant develop normally, it is evident that each sorus or each group of sori develops from a separate infection. It would appear as if the infection takes place about the time the plants are in flower.

The sori vary in size from that of a small pea up to 26–30 mm. in length by 15 mm. in width. They are usually ovoid or cone shaped, being widest near the base and gradually tapering to the tip. They are whitish or slightly grey in color. A sorus (Plate 20, Fig. 2) consists of a hard false membrane enclosing a mass of spore balls which are separated from each other by a network of mycelial threads. The false membrane is about a half millimeter or more in thickness and is somewhat leathery in texture. The spore balls vary somewhat in size up to a diameter of slightly more than 300 μ. Each spore ball (PLATE 20, FIG. 3) consists of a single layer of spores surrounding a large central portion made up entirely of sterile pseudoparenchymatous cells. The spores are nearly spherical in shape and about 11–13 μ in diameter. These measurements are slightly less than those given by Clinton (13–16 μ). The heavy brown wall of the spore is slightly granular or reticulate.

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[1] Clinton, G. P. Ustilaginales. N. Am. Fl. **7**: 45. 1906.

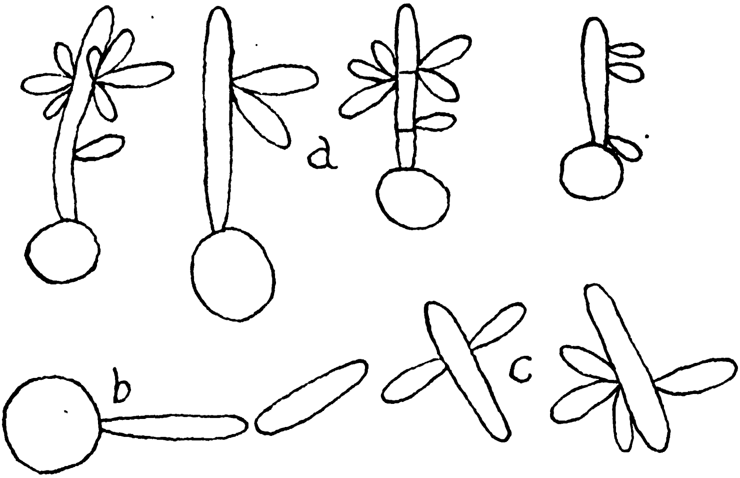
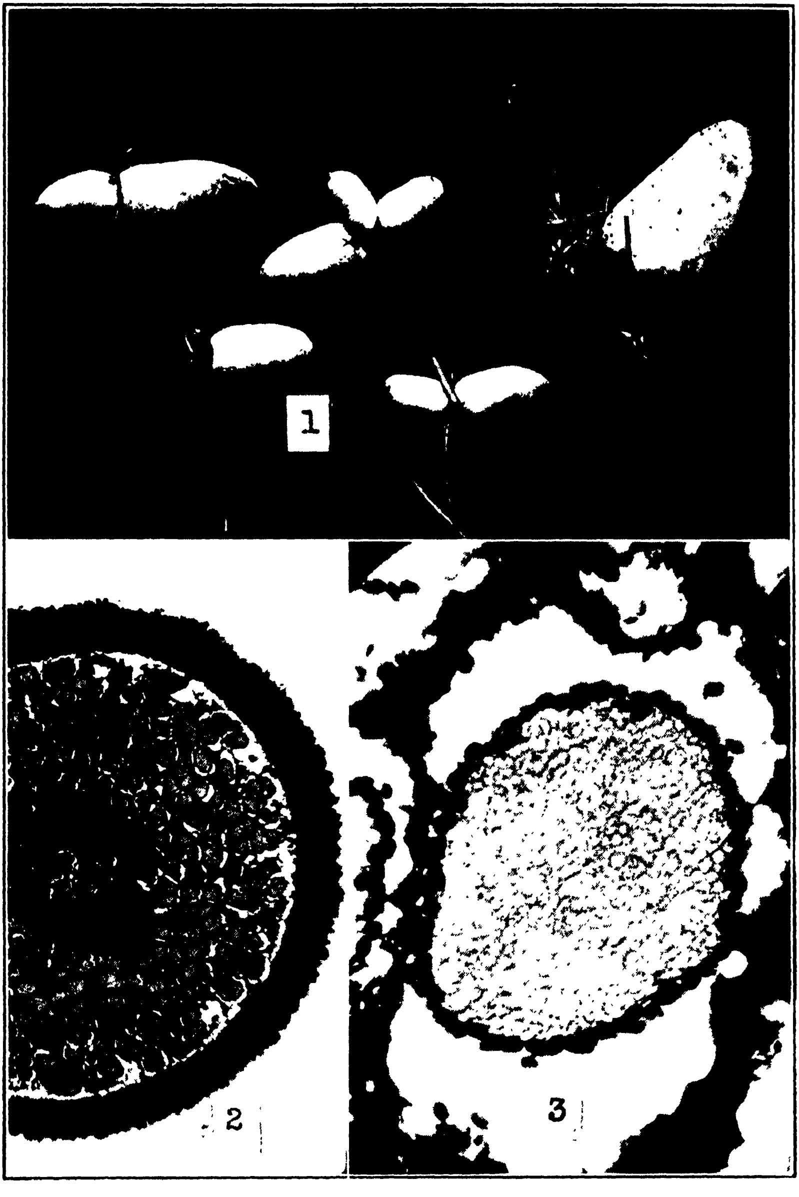


FIG. 1. Outline drawings of spore germination of *Testicularia Cyperi:* (a) formation of sporidia on promycelium; (b) breaking apart of the promycelium; (c) sporidia formation of segments of the promycelium.

As Clinton states that the germination of the spores of *Testicularia Cyperi* is unknown, some tests were made. The spores germinate very readily at maturity if placed in water or a weak sugar solution. A promycelium is produced which later becomes more or less septate though the septa are not always clear. As is characteristic of the family Ustilaginaceae, the sporidia develop on the side of the promycelium (TEXT FIG. 1*a*). A large number of sporidia may be produced by a single one. In drop cultures, the promycelium, or a portion of it, detaches itself from the empty spore at the least jar and continues to develop the small elongated sporidia for some time (TEXT FIG. 1*b*, *c*).

An attempt to germinate spores which had been kept in the laboratory in a dry condition from August until February was



TESTICULARIA CYPERI

not successful. Not a spore that had been dry that length of time would germinate.

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EXPLANATION OF PLATE 20

Fig. 1. Sori of *Testicularia Cyperi.* Natural size.
Fig. 2. Cross section of sorus. Magnification 15 ×.
Fig. 3. Cross section of spore ball. Magnification 245 ×.

A NEW SPECIES OF ARAIOSPORA FROM BRITISH GUIANA[1]

DAVID H. LINDER

(WITH PLATE 21)

Heretofore, *Araiospora*, one of the less well known members of the Leptomitaceae, has been found only in temperate countries, and there but rarely. The previous records of the occurrence of this genus, while few in number, might perhaps be regarded as indicating its restriction to temperate conditions. For example, Thaxter (2) has described *Araiospora pulchra* Thaxter, from Maine and Massachusetts, and Cornu (1) and von Minden (3) have recorded *Araiospora spinosa* (Cornu) Thaxter, from France and Germany respectively. While collecting in British Guiana as a Sheldon Travelling Fellow from Harvard, however, the writer discovered another species there under really tropical conditions, only seven degrees north of the Equator. It was first found rather commonly in the flat clayey coastal region around Georgetown growing on submerged or partly submerged fruit of *Spondias lutea* Linn. (hog plum), on the more or less soft inner surface of green cocoanut husks, and also on recently fallen and submerged twigs. Later it was collected among the sandhills in the vicinity of Bartica, on the Essequibo River system, growing on the submerged fruit of a member of the Bignoniaceae. From its occurrence on several substrata, in Georgetown and in Bartica, it would appear to be widespread, but it should be noted that when thus found the fungus was always in its zoösporangial or non-sexual stage.

The oögonial or sexual stage was sought for at different seasons of the year—before, in the middle, and at the end of the rainy season—but with no success. Whether light, a change in temperature, a combination of change in temperature and dilution of organic material by the rains, or even the presence of a complementary strain, are required to institute the formation of the perfect stage, is yet to be solved. At all events, from these collections, the indications are that the asexual method of reproduction is sufficient to perpetuate the species under tropical conditions.

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[1] Contribution from the Cryptogamic Laboratories of Harvard University, No. 93.

In order to make a comparison with what others had found in temperate countries, the development and morphological characters of the non-sexual stage of this tropical species was studied. Gross cultures were made, but unfortunately lack of equipment for making pure cultures prevented experiments of a physiological nature to determine what might cause sexual reproduction. The development as thus worked out was found to be typically as follows. The zoöspore on being set free, swims about, later comes to rest, loses its cilia, rounds up and shortly begins to increase in size until it is approximately three times its original dimensions, and then puts out a germination tube (PLATE 21, FIG. 1–2). This tube branches (PLATE 21, FIG. 3), developing into a rhizoidal system which penetrates deeply and ramifies in the substratum, sending back a supply of food that makes possible the elongation of what was formerly the swollen zoöspore body, but which now becomes the basal cell (PLATE 21, FIG. 4). This basal cell elongates and during elongation a definite concentration of protoplasm may readily be observed at the apex from which the sporangiophores and sporangia will arise.

In the majority of cases observed the sporangiophores grow out first, elongating until three or four of the constrictions peculiar to the order are formed and then the sporangia are produced at the tip of the last segment (PLATE 21, FIG. 5*a*, *b*). But such is not always true, for occasionally one finds both sporangia and sporangiophores at the tip of the basal cell (PLATE 21, FIG. 5*c*). This latter condition suggests interesting points for consideration. The suppression of zoöspore production in the sporangia and their resulting proliferation by hyphae is not uncommonly met with in certain genera of the Saprolegniales and in the genus *Phytophthora* of the Peronosporales. Likewise, in the fungus under discussion, if a group of sporangia at the end of a sporangiophore be examined (PLATE 21, FIG. 7), there may frequently be found among them one or more sporangia that are conspicuously longer than those that have already discharged zoöspores or appear about to do so. These elongate sporangia subsequently turn out to be sporangiophore initials. In addition, sporangia may be fully formed, only to produce, not zoöspores, but sporangiophores which grow out from the papillae (PLATE 21, FIG. 6). Since this same proliferative activity occasionally takes place at the apex of the basal cell, then the first constriction, at the basal cell, also may be considered a result of the proliferation of a potential sporangium in the manner previously described for the sporangiophores.

In the earlier stages of development, the sporangia produced are entirely of the smooth, elongate-elliptical type such as is found in the related genus, *Sapromyces*, with no ornamentation around the papilla. Later on, after the fungus has grown for some time, a second type of sporangium takes the place of the first to a considerable extent, though both kinds are occasionally found on the same plant (PLATE 21, FIG. 10). This second type resembles the smooth one, but is, on the average, larger in size. It differs also in having from four to six finger-like projections surrounding the apex of the sporangium around the already opened, or as yet still closed papilla of dehiscence (PLATE 21, FIG. 12–13). These projections give to the sporangium the general appearance of a basidium with from four to six stout sterigmata (PLATE 21, FIG. 10–11). A gross culture, made from the same material from which this specimen was taken, was grown for two weeks, but in that time not one of the spinose sporangia was produced. This would seem to indicate that the secondary form occurs only after considerable growth. Von Minden states, as a result of his culture experiments with *Araiospora spinosa*, that the spinose sporangia arise "unter ungünstigen Ernährungsbedingungen," while the smooth sporangia are produced when the plant enjoys an easily available source of nourishment. Such may be the explanation in the case of this tropical species as well. Furthermore, he believes that these spinose sporangia have a longer resting period, but the writer has no evidence either for or against this.

The further history of a primary or smooth sporangium is as follows. At about the same time that the content of the sporangium has begun to differentiate, or slightly before, a plug of modified fungus cellulose that stains more deeply wine red with zinc chloriodide than do the cell walls is laid down in the constriction at the base of the sporangium, thus separating it from the sporangiophore. Occasionally, even when differentiation of the content of the sporangium has proceeded to a considerable degree, a minute isthmus or thread of protoplasm may be seen connecting the sporangium and the sporangiophore. In the process of differentiation of the sporangium, the protoplasmic content, viewed from the surface, breaks up into dense irregular hexagonal masses which have not as yet assumed the typical zoöspore form. Discharge takes place then through an opening made by the pushing out of a thin-walled area at the tip of the sporangium to form a papilla, the end of which is usually apparently dissolved rather than ruptured, as shown by the tapering of the wall and the relatively smooth edge at the mouth (PLATE 21, FIG. 9). Pressure from within, however, also plays an important part in the formation of the papilla and in the discharge of zoöspores if we may judge by the fact that the intervals between the escaping spores increase successively, and by the fact that in the early stages of sporangial discharge the zoöspore emerges through the papilla without the aid of cilia, as these do not develop until the zoöspore has remained at the mouth of the sporangium for a short time.

Typically the zoöspores, which may be partially delimited at the time, emerge from the sporangium surrounded by a thin membrane, the bladder mentioned by von Minden for *A. spinosa* and by Thaxter in the case of *Rhipidium americanum*. This is soon broken by the increasing number of spores that are exuded from the sporangium, and the resulting mass becomes a loosely cohering one from which the spores escape by drawing apart and rounding off. Later, however, the zoöspores emerge singly through the papilla of discharge and after a brief pause at the mouth during which there is a slow twitching movement while the spore assumes its characteristic size and shape, it swims away. On one occasion, the intervals between the spores as they escaped one at a time were measured and found to vary from four to nine seconds, the lapses becoming greater as the number of spores remaining in the sporangium decreased. Occasionally, when only a few spores are left, these mature, churn around, later come to rest, and then germinate within the sporangium, producing germ tubes that grow out through the papilla or even through the surrounding walls.

DISTINGUISHING CHARACTERS OF THE FUNGUS

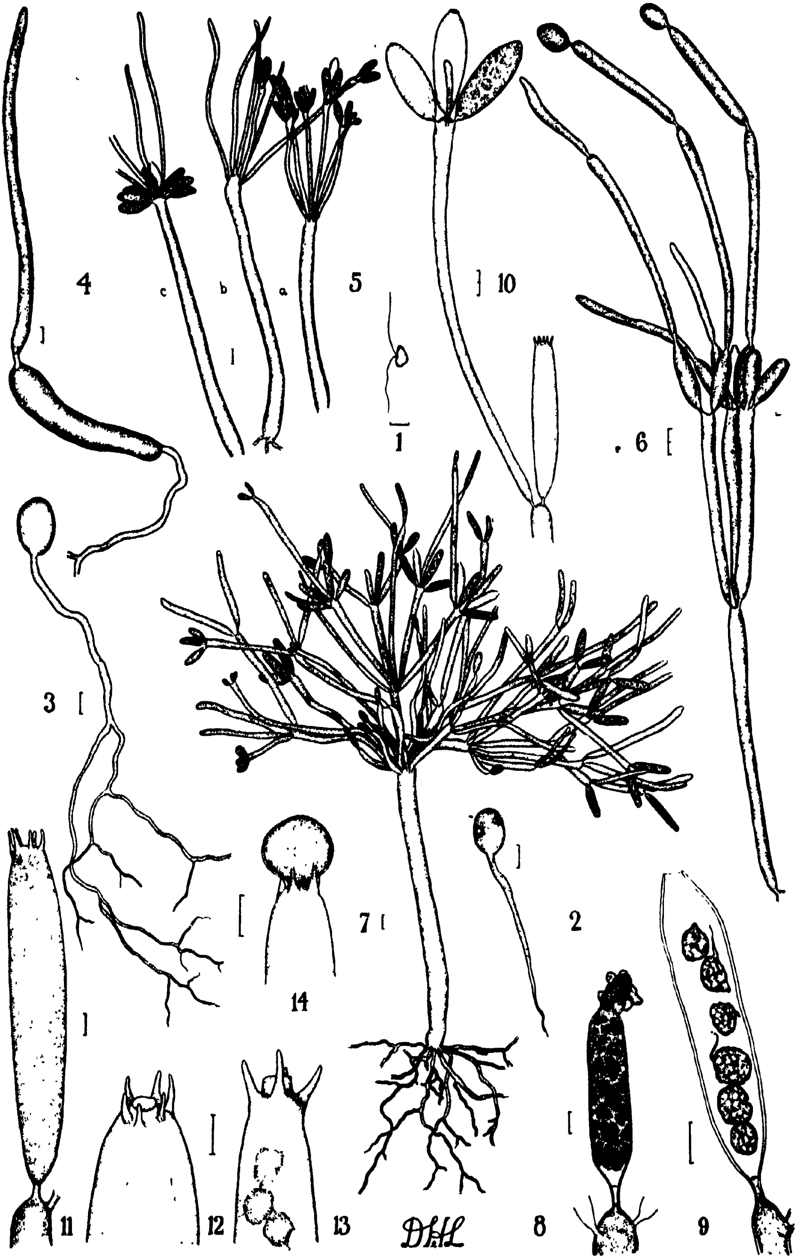
This British Guiana species of *Araiospora*, in its earlier stages, resembles rather closely *Sapromyces Reinschii* (Schröt.) Fritsch as described by Thaxter, except that the basal cell is more robust in the former. The resemblance to *Sapromyces* persists through the formation of the smooth, primary sporangia and is not lost till later in the course of development when the second type of sporangium, the spinose sporangium in the sense of Thaxter, is produced. This latter immediately sets this apart from *Sapromyces* and shows clearly that it belongs to the genus *Araiospora*. From *Araiospora pulchra* it is readily distinguished by the fact that the entire surface of the sporangium is not covered by stout radiate spines, but instead, these spines, four to six in number, are restricted to a ring around the base of the apical papilla, thus resembling more the conditions in *A. spinosa*. However, this species may easily be separated from *A. spinosa* by the short and straight or only slightly curved spines (PLATE 21, FIG. 10–13), as contrasted with the very long recurved ones of the latter. These are the outstanding characters of the British Guiana material, but in addition it differs markedly in other dimensions, as shown in the following table:

	A. pulchra	*A. spinosa*	*A. coronata*
Basal cell	1,000–1,500 × 25–50 μ	800 × 160 μ	826–846 × 45–48 μ
Smooth sporangium	120–175 × 30–35 μ	90–150 × 45–60 μ	63–85 × 11.5–16.2 μ
Spinose sporangium	45–60 × 48–70 μ	100–150 × 40–80 μ	68–130 × 12–26 μ
Spines	10–35 μ	60–70 μ	7–9 μ

Although the perfect stage is lacking, it seems quite justifiable to describe this, even on its asexual characters, as a distinct species.

Araiospora coronata n. sp.

Basal cell subcylindrical, 826–846 × 45–48 μ, with well developed branched rhizoidal system at the base, and giving rise to few or many sporangiophores at the rounded apex. Sporangiophores with constrictions and repeatedly and umbellately branched, the segments successively more elongate and slender. Zoösporangia elongate-elliptical to subcylindrical, occurring singly or in whorls of two to six, terminating the branches or at



ARAIOSPORA CORONATA

the distal ends of the segments which make up the branches. Sporangia of two types: simple sporangia smooth, 63–85 × 11.5–16.2 μ; spinose sporangia with 4–6 short (7–9 μ), straight or slightly curved finger-like spines in a circle around the apical papilla of discharge, 68–130 × 12–26 μ. The entire plant 5 mm. in length. Oöspores not observed.

Growing on submerged fruit and twigs, British Guiana, South America.

Type material in the Farlow Herbarium and the herbarium of the writer, No. *258*.

In conclusion, the writer wishes to express his indebtedness to Dr. Roland Thaxter and Professor William H. Weston, Jr., for advice and criticism, and to Mr. L. D. Cleare, Jr., Government Entomologist of British Guiana, for the many courtesies extended during and after the writer's stay in that country.

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EXPLANATION OF PLATE 21

All drawings were made from material mounted in glycerine and eosine, with the exception of figures 1, 2, 6, and 8, which are from living material, and were drawn by the aid of a camera lucida. Each division of the scale or the whole scale if undivided, equals 10 μ.

Fig. 1. A typical biciliate zoöspore. × 260.

Fig. 2–3. A swollen zoöspore body which has given rise to a germ tube that later becomes a branched rhizoidal system as shown in fig. 3. × 260.

Fig. 4. A more advanced stage showing the basal cell derived from the swollen zoöspore body by enlargement and elongation. At the apex of the cell is produced a single sporangiophore that is followed later by several more, or by sporangia. × 180.

Fig. *5a–c*. A group of young plants bearing sporangia. The plant on the left (*5c*) shows sporangia being borne directly on the basal cell. It should be noted that all the sporangiophores and sporangia have the same constriction at the base, thus indicating the proliferative process that is more obviously illustrated in the following figure. × 36.

Fig. 6. A terminal branch of a much elongated plant. The sporangia have proceeded rather far before environmental conditions checked zoöspore

differentiation and caused the formation of sporangiophores instead. When this differentiation has taken place to a lesser extent, the hyphae do not have the swollen base or the constriction that indicates the previous presence of a potential sporangium. Among the proliferated sporangia may be seen one that has discharged its spores. × 150.

Fig. 7. A young plant, one and one half weeks old, showing the exclusive production of the smooth or primary type of sporangia and the successive putting forth of sporangiophores from the apex of the basal cell. The rhizoidal system and also the repeatedly umbellately branching sporangiophores are clearly indicated. × 36.

Fig. 8. An enlarged mature sporangium with contents differentiated, emitting zoöspores as a loosely cohering mass. × 260.

Fig. 9. A much enlarged smooth sporangium containing a few remaining spores that have not as yet become entirely differentiated into active motile zoöspores. The modified fungus cellulose plug that is formed in the constriction at the base of the sporangium, in the early stages of the breaking up of the content of the sporangium into hexagonal masses, may be seen surmounted by a button-like mass of similar material. Also, the tapering of the walls around the mouth of the papilla of discharge may be observed. × 500.

Fig. 10. A terminal portion of a conidiophore showing the smooth and the spinose types of sporangia. It should be noted that one sporangium of each type has already discharged its spores, thus leaving no doubt as to the maturity of the sporangia. × 180.

Fig. 11. The spinose type of sporangium, more highly magnified, with its differentiated protoplasmic content, showing the arrangement of the spines around the apex before the formation of the papilla of discharge. × 260.

Fig. 12–13. Greater magnifications of the terminal portions of the sporangia to illustrate the arrangement of the six, and also the four, spines around the discharge papilla. × 500.

Fig. 14. An early stage in the escape of zoöspores. Here the spores may be seen, as yet not entirely delimited, surrounded by a thin membrane, the vesicle in the sense of von Minden. This condition precedes that illustrated in figure 8. × 500.

MYCOLOGICAL NOTES FOR 1925 [1]

L. O. OVERHOLTS

(WITH PLATE 22 AND 1 TEXT FIGURE)

1. GLOEOSPORIUM QUERCINUM West.

In collecting class material of a *Phyllosticta* on *Castanea* this fall I found two leaves with one or two spots about 1 cm. in diameter, and bearing numerous hypophyllous acervuli of a *Gloeosporium.* Not finding a *Gloeosporium* listed on *Castanea* I sent one of the leaves to Prof. Dearness who writes that the fungus cannot be distinguished from *G. quercinum* West. as determined by J. B. Ellis. The description in Saccardo (**3**: 714) records the spores as 5–6 × 2.5 μ. My measurements are 6–7 × 2 μ. If the fungus is correctly referred to this species, *Castanea* is, I think, an unreported host. On *Quercus* it is certainly uncommon in Pennsylvania, since several years of rather intensive collecting have failed to reveal its presence.

2. CERCOSPORA MAIANTHEMI Fuckel.

This uncommon species on *Maianthemum canadensis* was collected at Trout Run, Lycoming Co., Pa., in June of this year. The hypophyllous tufts of conidiophores, arising from a distinct subepidermal plectenchymous mass, are easily visible to the unaided eye. The spores are 4- to 10-celled at maturity and measure 50–110 × 5–6 μ. They are practically colorless or slightly smoky under the microscope.

3. PHLYCTAENA SEPTORIOIDES Sacc.

The following notes were made from specimens collected at State College, in February, 1925, on stems of *Phytolacca decandra*, and identified by Professor Dearness.

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[1] Contribution from the Department of Botany, The Pennsylvania State College, No. 54. Published by permission of the Director of the Agricultural Experiment Station, as Technical Paper No. 408.

Caulicolous on extensive whitened areas several centimeters in extent; pycnidia thickly scattered, erumpent and appearing more or less superficial, black, elliptic to subcircular, $^1/_5$ to $^1/_3$ mm. in length, opening at maturity by a fissure; spores linear, curved, hyaline, one-celled, 15–21 × 0.5–1 μ.

4. DISCOSIA ARTOCREAS (Tode) Fr.

Though reported on a wide range of host plants, and even on cones of *Pinus* sp. by Saccardo, I find no definite record of its occurrence on cones of *Pinus Strobus*. It was collected in Stone Valley, Huntingdon Co., Pa., in May, 1925, on an immature cone lying on the ground. Search for other cones and an examination of normal mature cones failed to show its presence. It seems to me that the spores are very slightly fuscous as seen in mass under the microscope.

5. GONATOBOTRYUM MACULICOLA (Wint.) Sacc.

Gonatobotryum is a peculiar and little known genus of imperfect fungi of the family Dematiaceae, with the conidia borne in groups in swollen node-like areas of an erect conidiophore as seen in the accompanying illustration (TEXT FIG. 1*A*). The species was well described by Winter in 1883 in Hedwigia, from Pennsylvania collections by Rau. Though I have collected it for several years, this is the first season I have had satisfactory sporulating material. Apparently the spores are produced early in the season, a collection made at Charter Oak, June 24, being in excellent condition. The spores are soon shed and later in the season the fungus is not in condition for satisfactory determination, though the conspicuous conidiophores persist. Later I find a *Phyllosticta* inhabiting the spots with the *Gonatobotryum*. The following notes were made from the Charter Oak collection:

Spots circular, 1–4 mm. in diameter, or by confluence larger and more irregular, red brown with a slightly darker margin; conidiophores amphigenous, erect, dark brown and hair-like, 180–400 μ high, 15–18 μ thick at the base, 8–12 μ at the apex, septate, with one or two slightly inflated nodes that are conidia-bearing; conidia on very short stalks that give an echinulate appearance to the nodes after the spores are shed, soon deciduous, the spores many at each node, pale brownish, ovoid or narrow fusoid, smooth, 6–12 × 3.5–4 μ.

On leaves of *Hamamelis virginiana*. Common.

6. CRUMENULA on *Pinus pungens* and *P. rigida*.

On May 8, 1925, the writer discovered at Greenwood Furnace, Huntingdon Co., Pa., evidence of rather extensive twig injury on *Pinus pungens* by a species of *Crumenula* that appears to be close to if not identical with *C. pinicola* (Rebent.) Karst. The injury is confined to the terminal twigs of the lateral branches and involves the twig growth for the last 6 years or less (PLATE 22, FIG. 1). The fungus fruiting bodies are on definite though not conspicuous cankered areas, over which the diameter of the stem has increased to a noticeable extent until it has become somewhat fusiform (PLATE 22, FIG. 2). Only a few of the small black apothecia are produced on each canker or swelling (PLATE 22, FIG. 3). They measure 1 to 3 mm. in diameter and are entirely black in color. In every case the twig is killed distally to these cankered areas. The general appearance of the disease and the nature of the cankers and the fruiting bodies is brought out in the accompanying illustrations. Other pines, including *P. virginiana*, *P. rigida*, and *P. Strobus*, though growing indiscriminately mixed with *P. pungens* were not attacked. The attacked trees are probably 15 to 20 years of age and are growing in situations well suited to that species.

The same fungus had previously been found in November, 1921, on *Pinus rigida* at a locality about six miles from the 1925 collection. Here also definite injury was present as evidenced by the dead terminal twigs and the definite cankers that exuded considerable resin. On this occasion it was found on but one tree, nearby trees of the same species and of *Pinus Strobus* being uninfected. Attempts to obtain a specific determination were not successful on that occasion.

The plant is easily recognized by the fact that when the apothecia are crushed in KOH the entire mount quickly becomes a conspicuous greenish blue color and the asci become greenish blue under the microscope. The spores, according to Rabenhorst, are "meist einzellig," and in the 1921 collection only one-celled spores were seen. In the later collection, however, some two-celled spores are present. They are very narrow-fusoid or

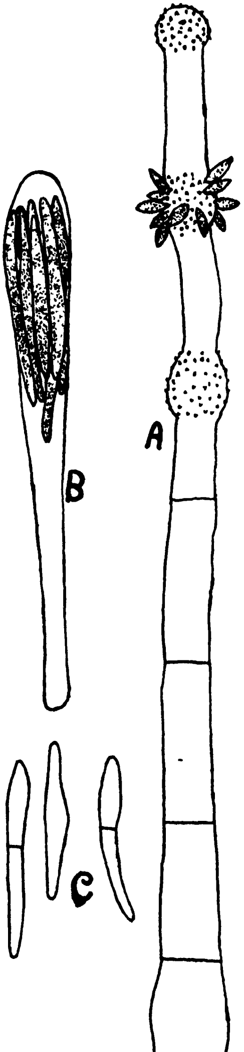


FIG. 1. A, Conidiophore of *Gonatobotryum* showing nodes with spores and short sterigmata. B–C, *Crumenula pinicola*, ascus and mature spores.

narrow-clavate and measure 27–28 × 2.5–4 μ (TEXT FIG. 1*B*, *C*). The paraphyses are dichotomously forked at the tip. Superficially the apothecia are almost exact counterparts of those of *Cenangium Abietis*, which however has very different spores and does not develop the characteristic color of the plants here under discussion.

7. MELAMPSORA BIGELOWII Thuem. on *Salix* stems.

Melampsora Bigelowii was first observed on the woody stems of *Salix* at Greenwood Furnace, Pa., in the spring of 1920. A few years previous a small willow holt had been established there, the species used being apparently *Salix pentandra* or *S. purpurea*. Since Bethel's discovery of *M. Bigelowii* perennating on the woody stems of *Salix* the writer had been watching for this phenomenon in the east. The Greenwood Furnace location was known to be many miles from any native or planted *Larix* that would harbor the aecial stage, yet the uredinial and telial stages occurred every year on the leaves of the *Salix*. The first collections of the uredinial stage on the wood were on one-year-old stems and were found in the spring of the year when the willows were being harvested. Since 1920 these willows have not been cut, and now are 8 to 9 feet tall and 5 years of age. In May, 1925, the rust was again found to be fairly common in the holt, fruiting now exclusively on wood that is three, four, and five years old. Some cankers on each of these age classes fruited this year for the first time (PLATE 22, FIG. 4). Others are fruiting for the second time (PLATE 22, FIG. 5), but none could be found on which the rust was perennating to a greater extent. Either the mycelium actively invades the cambium and phloem cells, causing their death, or else the bursting of the bark by the uredinial pustules causes these tissues to dry out and die. The latter situation would in itself undoubtedly be sufficient cause of the death of these cells. Whatever may be the case, conspicuous cankers are formed, as shown in the illustration, and many of the stems are killed. In some of these the fungus seems to last only a single season, at least many two-year-old cankers are not fruiting this year, though the stem is yet alive. In others the fungus seems to persist in the same canker, providing of course that the tree does not die.

This year a series of these cankers have been tagged and will be kept under observation in order to determine how long the fungus persists in the wood.

8. PUCCINIA TENUIS Schw.

The only Pennsylvania collection of this rust noted is the type collection from Bethlehem, Pa. It was collected this year at Trout Run, Pa., on *Eupatorium urticaefolium*, its only recorded host, by Overholts and Denniston in June. Spores 13–16 × 12–15 μ. The species is distinguished from *P. Eleocharidis* Arth. in its aecial stage by the much smaller spores and by the fact that up to the present time the latter species has not been recorded on *E. urticaefolium*, though on several other species of the genus.

9. WITCHES BROOM on *Quercus Prinus*.

At Bear Meadows, Center Co., Pa., a witches broom was found in the top of a tree of *Quercus Prinus* about twenty-five feet tall. This is the first time a witches broom has been found on this genus of trees in Pennsylvania. The specimen was collected in February when it was impossible to verify the presence of a leaf fungus such as a *Taphrina* or an *Exoascus*. Search of the literature shows *Taphrina Kruchii* Vuill. to be recorded as causing brooms on this host, but the causal agent in this case cannot be determined at this time.

EXPLANATION OF PLATE 22

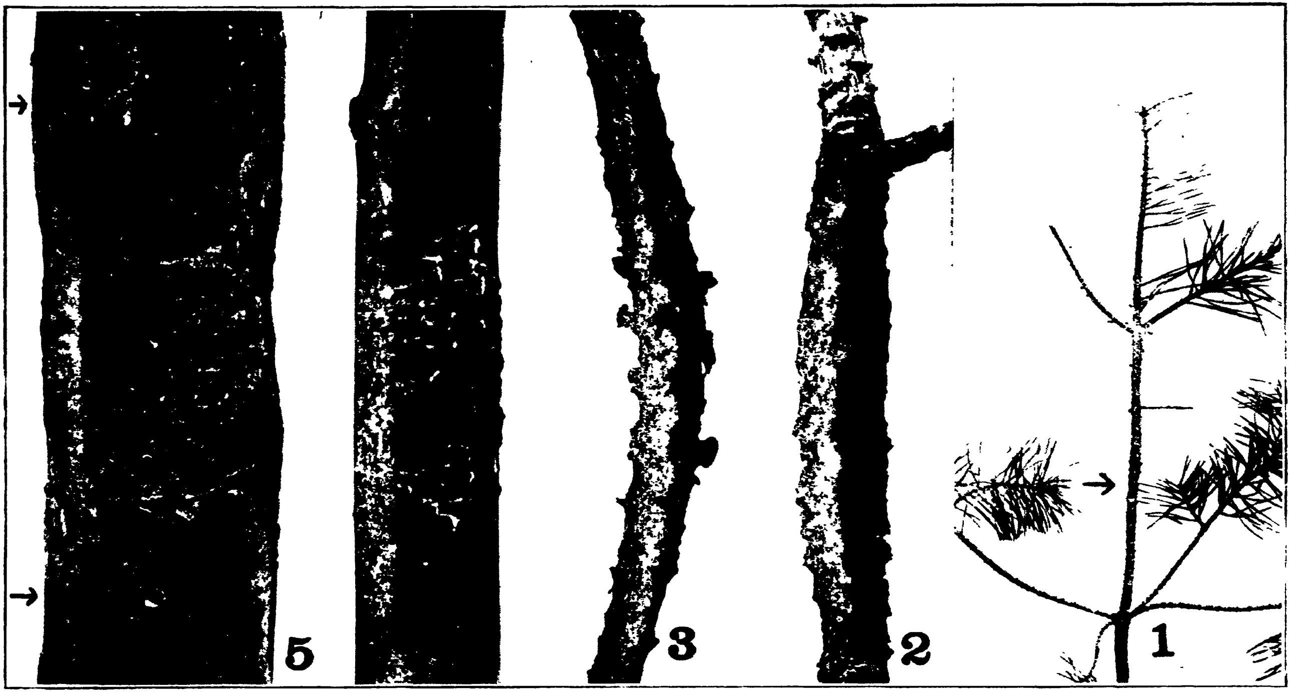
Fig. 1. Terminal branch of *Pinus pungens* showing effect of *Crumenula*. Canker and apothecium near the arrow. × 1. Overholts Herb. No. 9733.

Fig. 2. Fusiform canker on *Pinus pungens*, caused by *Crumenula*. Slightly enlarged.

Fig. 3. Cankered area bearing the black apothecia of *Crumenula*. Slightly enlarged. No. 9733.

Fig. 4. Stem of *Salix* with *Melampsora Bigelowii* in fruit for the first time. × 1. Overholts Herb. No. 9729.

Fig. 5. Living stem of *Salix* with *Melampsora* canker that fruited abundantly in 1924 but is fruiting only sparingly in 1925, both above and below the area of last year's fruiting and opposite the arrows. × 1. Overholts Herbarium No. 9729.



1–3. CRUMENULA ON PINUS PUNGENS
4–5. MELAMPSORA ON SALIX

BANANA FRECKLE AND LEAF SPOT

O. A. REINKING

After a careful examination made in Hawaii and the Philippine Islands, the banana freckle or black spot disease as described by Carpenter (8) from Hawaii has been determined to be caused by the same fungus producing a disease called leaf spot of banana (6) (7) in the Philippine Islands. At the time that the leaf spot disease was described in the Philippines no report of the fungus on the fruit was made. Lee (9) some years later reported the presence of banana freckle on the fruit in the Philippine Islands and reported the disease to be the same as that found in Hawaii. No reference was made to the similarity of the organisms causing the leaf spot and the fruit spotting. The recent investigation indicates that the two diseases are the same and similar to the banana freckle described by Carpenter as occurring in Hawaii and therefore are caused by the same fungus, *Macrophoma musae* (Cooke) Berl. & Vogl. A literature review of the organism in question may also clarify an apparent mistake in nomenclature.

In 1884, Saccardo (1) described a fungus on plantains as follows under the name of *Phoma Musae* (Cooke) Sacc.

593. *Phoma Musae* (Cooke) Sacc. *Sphaeropsis? Musarum* Cooke in Grevillea.

Peritheciis semiimmersis, atris, nitidis, subconicis, in maculis parvulis congestis; sporulis subglobosis vel ovatis vel ellipticis, hyalinis, 12–22 = 10–14, basidiis nullis visis.

Hab. in *Musa paradisiaca*, Belgaum in India orientali.

The fungus was then, in 1886, redescribed by Berlese and Voglino (2) as *Macrophoma Musae* (Cooke) Berl. & Vogl. In 1892, it was so listed by Saccardo (3). In 1913, Sydow (4) enumerated the fungus *Macrophoma Musae* (Cooke) Berl. & Vogl. after having examined infected material of banana and plantain from the Philippine Islands.

Spore measurements made of the fungus from the leaf in the Philippines compare favorably to the fungus described by Carpenter in Hawaii. The following measurements were found for the conidia: 8.5–20 × 6.75–11.75 μ. The fungus also compared favorably in all other respects as described by Carpenter (8) and Berlese and Voglino (2). The two fungi, therefore, may be regarded as the same. Since the name *Phoma Musae* had already been used for a species of fungus on *Musa* and later this same organism was redescribed as *Macrophoma Musae*, and because the fungus causing the leaf spot and freckle of banana in the Philippine Islands compares favorably with the organism described as producing banana freckle or black spot disease in Hawaii, it is suggested that Carpenter's *Phoma Musae* be reduced to a synonym of *Macrophoma Musae* (Cooke) Berl. & Vogl. The disease known as banana freckle and black spot will then have to be designated as being caused by *Macrophoma Musae* (Cooke) Berl. & Vogl.

While conducting the investigation in Hawaii it was observed that the Gros Michel banana of Central America was apparently resistant to the disease. No infection was noted on this variety even when growing adjacent to heavily infested bananas of the Chinese Dwarf variety. A large number of varieties in the Philippines are infected. The socalled red variety of Saba (Sabang Pula) in the Philippines is severely affected on leaf and fruit.

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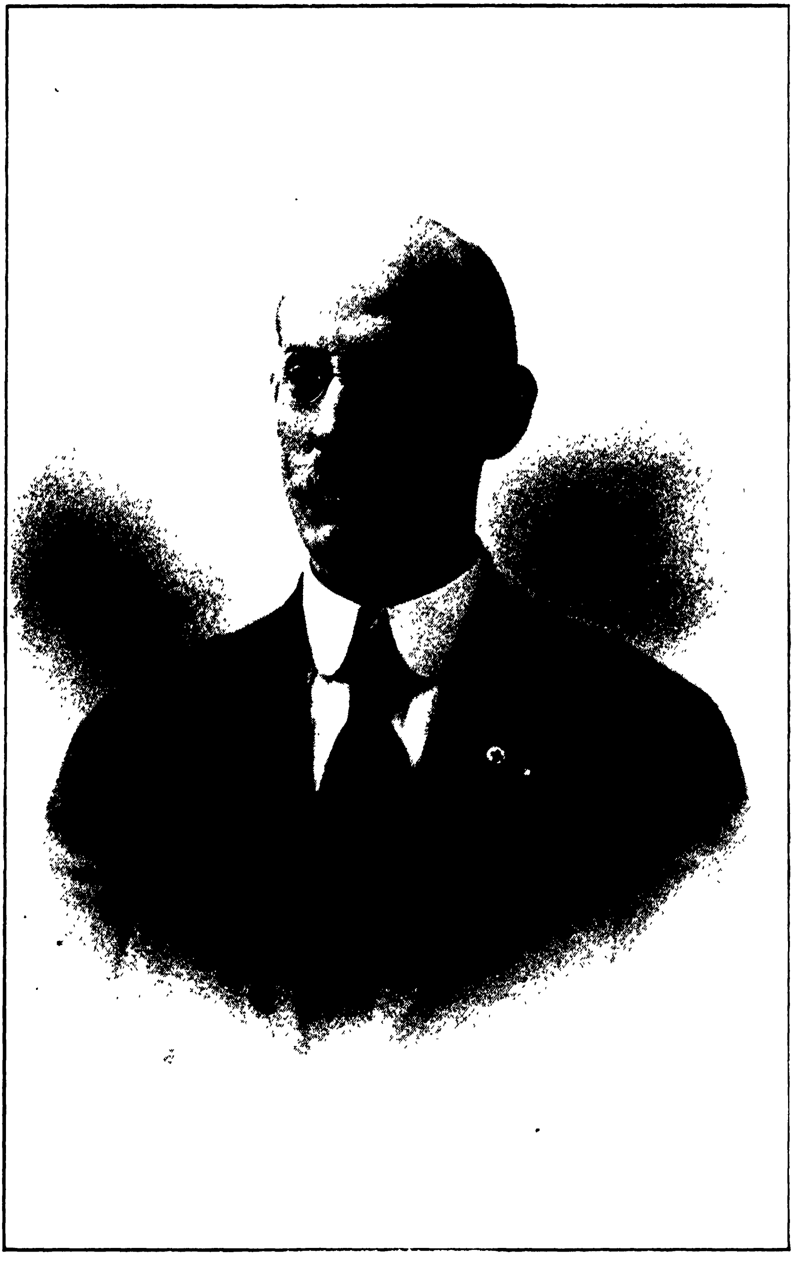

ELLSWORTH BETHEL

ELLSWORTH BETHEL

(WITH PORTRAIT, PLATE 23)

We here present a recent photograph of the late Ellsworth Bethel, whose unexpected death was noted in an earlier number of MYCOLOGIA. Although not exclusively a mycologist he was sufficiently prominent in this field to deserve more than a passing mention. Born in Ohio, June 20, 1863, he migrated to Colorado in 1890, where he soon attained prominence as a teacher and an all-around naturalist. He was a graduate of Scio College and of the East Tennessee Wesleyan University, and in 1905 he received an honorary degeee of M.A. from the University of Denver.

My own personal acquaintance with Mr. Bethel is almost coextensive, in point of time, with my interest in mycology. From about 1904 until the day of his death (September 8, 1925) we were rather closely associated in things mycological and it is difficult to go far in the herbarium without encountering fungi collected in Colorado by Bethel.

When I first visited Colorado in 1910, Mr. Bethel's company on a number of trips into the mountains was a great help and inspiration. Several days were spent together at Tolland; also in Geneva Creek Canyon and in the vicinity of Boulder. On all of these occasions he seemed to have unlimited physical energy and boundless enthusiasm for the work. He was an omnivorous collector.

While the number of mycological titles accredited to him is surprisingly small, his collections have furnished the groundwork for a number of articles contributed by other mycologists. In "The Myxomycetes of Colorado. II."[1] Dr. W. C. Sturgis states: "Up to 1907 I had the invaluable assistance of Mr. Bethel, of Denver, an able and tireless collector, thoroughly acquainted with all parts of Colorado." Of the 94 species of slime-moulds reported from Colorado in the first paper by Dr. Sturgis a very large per cent represented the results of the field work of Mr. Bethel in this particular group. One species of slime-mould, *Physarum Bethelii* (Macbr.) Lister, has been dedicated to him and a fine colored illustration published by Miss Lister, the English authority on the slime-moulds.

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[1] Colorado Coll. Pub. Sci. Ser. **12**: 452. 1913.

He was especially interested in plant rusts, beginning their collection shortly after going to Colorado, and here again contributed much field information for other workers as well as several articles on his own account. One species, *Gymnosporangium Betheli* (*Roestelia Betheli* Kern), has been dedicated to him by Dr. F. D. Kern now of the Pennsylvania State College. Also *Aecidium Betheli* and *Uromyces Betheli* by Dr. J. C. Arthur and *Peridermium Betheli* by G. G. Hedgcock and W. H. Long, the latter species now regarded as a synonym of *Cronartium Comandrae.*

And in other fields of mycology he showed similar interest. Many interesting specimens of discomycetes have been sent to us in the course of the years. One cup-fungus, *Godronia Betheli,* named for him by the writer, was found to have an earlier name so must be relegated to synonymy.

In 1917 he began work for the United States Department of Agriculture in the office of Forest Pathology and was connected with this office until the time of his death. On October 3, 1924, he married Miss Dorothy S. Stokley of Philadelphia.

He has been a subscriber to MYCOLOGIA and loyal supporter of this periodical from its earliest inception. His loss will be keenly felt by mycologists.

FRED J. SEAVER

NOTES AND BRIEF ARTICLES

Dr. L. O. Overholts, of State College, Pa., would like to hear from anyone who has successfully worked out a scheme for drying fleshy fungi collected on long auto trips, where only overnight stops are made. Description of any method of utilizing the heat of the engine or of constructing some sort of drier that can be safely used in transit would be much appreciated.

Dr. C. J. Humphrey, for many years in charge of the forest pathology investigations at the Forest Products Laboratory, U. S. Forest Service, Madison, Wisconsin, and Lecturer in Forest Pathology at the University of Wisconsin, has resigned from the Department of Agriculture to accept the position of Mycologist, Bureau of Science, Manila, Philippine Islands, where he will direct the research work of the Bureau in mycology and plant pathology. He sailed from San Francisco on May 29 to assume his new duties.

The *National Geographic Magazine* for April, 1926, contains (421–443) an article by William Crowder entitled "Marvels of Mycetozoa" with the subtitle, "Exploration of a Long Island swamp reveals some of the secrets of the Slime Molds, dwelling on the borderland between the plant and animal kingdoms." This is a very interesting popular account of the life history of the Slime-Molds. The article is illustrated by photographs and 16 beautifully colored plates. The author is to be congratulated on his efforts to popularize an obscure corner of the plant world.

Dr. Frank D. Kern, of The Pennsylvania State College, and Mr. R. A. Toro, of the Insular Experiment Station of Porto Rico, spent the month of March in mycological investigations in Santo Domingo. The trip was made under the auspices of the University of Porto Rico and the Insular Department of Agriculture.

Dr. R. Ciferri, director of the Agronomy Experiment Station, Jaina, coöperated very effectively. Especial attention was given to the collection of Uredinales and Pyrenomycetes. About 400 collections were made. The season was not favorable for collecting owing to the dry conditions which prevailed and the consequent scarcity of foliage. These collectors report that they regard this as a preliminary trip which is to be followed later by a more extensive exploration.

Professor H. H. Whetzel visited the University of Florida from April 5th to April 8th on invitation of the president, Dr. Murphry. He delivered two addresses: one, on the subject of "The Relation of Teaching and Research" before the faculty, and another on "The Place of Science in a Modern College Man's Education" before the student body. A special collecting trip to one of the collecting grounds near Gainesville was put on by the members of the staff of the Department of Plant Pathology of the Experiment Station. Professor Whetzel was entertained at the home of Dr. Burger, head of the Department of Plant Pathology of the Experiment Station. Provisional plans were made for a coöperative fungous survey of Florida in the near future.

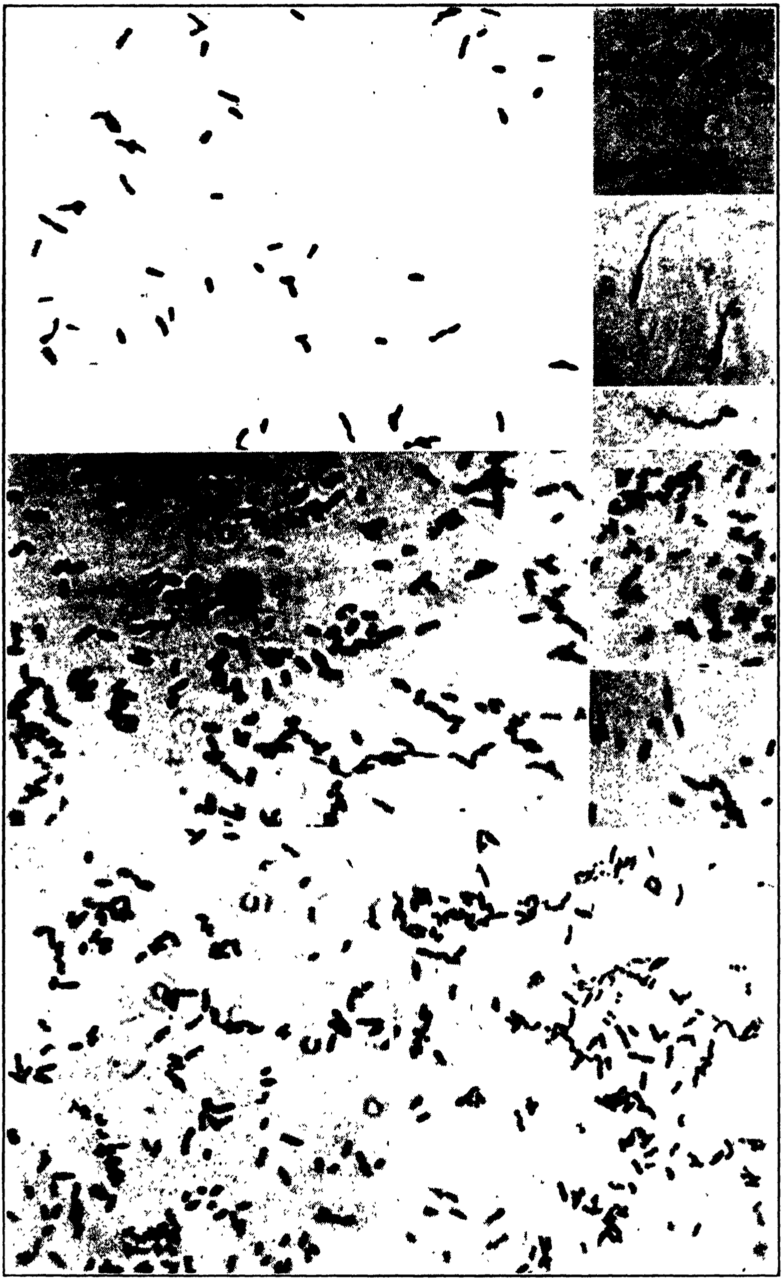
Investigations into the phenomena of sex in fungi—mushrooms and toadstools—carried on at the University of Manitoba by research students working under the direction of Dr. A. H. R. Buller has attracted the attention of the Dominion of Canada Research Council and the work is being officially recognized by that body. These workers—Misses Irene Mounce and Dorothy Newton and Mr. W. F. Hanna—have found evidence that a sexual process is initiated in the mycelium of mushrooms and toadstools before the fruit-bodies are started. Experiments made with species of *Coprinus* have led Dr. Buller and these workers to believe that in some of the species there are no less than four distinct sexes. The first experiments on sex in mushrooms and toadstools were made in 1918 by Mlle. Bensaude, a French lady. Thus far the only literature on this subject in English has been published from the University of Manitoba. JOHN DEARNESS

THE ASPERGILLI

An important new book has just appeared under the title "The Aspergilli" by Charles Thom and Margaret B. Church, of the Microbiological Laboratory of the Bureau of Chemistry, Department of Agriculture. This book consisting of 272 pages and a number of text figures represents the results of more than twenty years of study on the part of the senior author. The study was undertaken in connection with the economic phases of the question, especially the relation of these fungi to the decay of vegetables and fruits. The difficulties encountered in the determination of species have prompted the writers to put their work into such form that it may be used by subsequent workers.

Part I of this work comprising 90 pages is devoted to the history, the morphology, and the economic aspects of the problem. Part II consists of a taxonomic study with elaborate keys which are expected to enable the worker to identify his plant with a reasonable degree of certainty. Among the economic considerations, one of the interesting chapters is that devoted to the diseases of the animal body. Numerous reports of disease of the human body cite *Aspergilli* as the cause of characteristic lesions. The book appears to be very well arranged and will doubtless be a valuable asset to every mycological library.

FRED J. SEAVER



BACTERIUM TUMEFACIENS

MYCOLOGIA

VOL. XVIII SEPT.-OCT., 1926 NO. 5

MORPHOLOGICAL NOTES TOGETHER WITH SOME ULTRAFILTRATION EXPERIMENTS ON THE CROWN-GALL PATHOGENE, BACTERIUM TUMEFACIENS

H. R. ROSEN

(WITH PLATES 24 AND 25)

The recent work of Levine (8) on morphological changes in *Bacterium tumefaciens* is of considerable interest from a scientific as well as from a practical standpoint. Levine reports that smears from a three-months-old culture of this organism on bean agar, when stained with Loeffler's methylene blue, show an amorphous mass of jelly-like substance with occasional deeply stained minute spherical bodies. He reports that smears from young cultures, representing transfers from the old bean culture, show long rods which not infrequently present a beaded appearance. Likewise, he finds an abundance of small lenticular bodies staining heavily at both ends, while the central portions remain unstained. These bodies he takes to be spores which, when transferred to fresh media, germinate and give rise to a rod-like body not unlike *Bacterium tumefaciens* in size. Whether these bodies are to be regarded as comparable to the "minute spherical bodies" of the old bean culture is not stated, although it is noted that in old cultures the spores appear to lose their ability to stain and may be recognized as the bodies most abundant in the smear.

[MYCOLOGIA for July–August (18: 137–191) was issued July 1, 1926.]

The writer's first interest in the morphology of the crown-gall pathogene was from the point of view of staining its flagella, for, in spite of the enormous mass of literature which has accumulated on this organism and on the disease it produces, there is not a single clear photograph in any publication known to the writer showing the flagella. True it is that Smith, Brown, and Townsend (**12**, p. 107) give drawings of the organism showing flagella, and Smith (**13**) elsewhere presents a rather hazy photograph, but in view of the large numbers of excellent microphotographs of various sorts that have been published on the crown-gall disease, it is rather surprising to find such few photographs of the organism. In all probability, this may be explained by the fact that flagella of this organism are not easy to stain.

It must be noted that while the writer has been studying *B. tumefaciens* for upwards of two years, interpretation of various forms is still questionable to him. I shall simply state what these forms are and suggest certain possibilities as to their function. By means of the flagella stain which the writer has developed, excellent preparations have been obtained, showing not only the flagella (see upper part of PLATE 24), but also certain interesting features of the bodies themselves. That these have been clearly seen by this method is not surprising, inasmuch as it entirely eliminates heating the film in order to fix it to the slide, and hence eliminates a process (roasting or broiling would be a proper name for it) which is almost certain to destroy any minute structures within the body, as well as to render any irregularities in form uncertain of detection.

In young, vigorously growing cultures of *Bacterium tumefaciens*, representing transfers of cultures kindly supplied by Dr. A. J. Ricker of the University of Wisconsin, stained as above mentioned, the variation in size and shape of the rods is very conspicuous. (It must be emphasized that old cultures, or cultures in which the organisms make little or no growth, are not being considered at this time.) Vigorously growing culture as here used means one in which a very conspicuous growth along the whole length of a slant of nutrient agar kept at 28° C. is obtained in 18 to 24 hours. A large number of measurements of bacteria coming from such cultures and from cultures up to four days old, stained by the writer's flagella-staining method, show the following variations in size: 0.6 to 3.6 by 0.3 to 1.0 μ. As to relative frequency, measurements less than 1.0 μ for the long diameter are comparatively few, while measurements around 3.6 μ are also relatively few. The latter refer to figures in which two potential cells remain united and give no clear indications of being separate individuals, *i.e.* with no clearly distinguishable cross walls and without ends rounded at the point of contact. As to the short diameter, measurements below 0.5 μ are common, indeed just as common as measurements above 0.5 μ. A convincing picture of the diversity of sizes obtainable in *B. tumefaciens* may be obtained from the following measurements of organisms representing young cultures.

0.6 × 0.3 μ
0.9 × 0.5 μ
1.0 × 0.6 μ
0.8 × 0.3 μ
1.0 × 0.4 μ
1.2 × 0.7 μ
1.5 × 0.6 μ
1.2 × 0.4 μ
2.4 × 0.8 μ
1.5 × 0.4 μ
1.0 × 0.3 μ
1.2 × 0.5 μ
1.0 × 0.4 μ
3.5 × 0.8 μ
1.5 × 0.6 μ
0.8 × 0.3 μ
2.4 × 0.9 μ
3.0 × 0.9 μ
1.5 × 1.0 μ
3.6 × 0.8 μ

With such diversity, what significance may be attached to average or mean measurements? Hence the lack of close agreement among different workers on the same organism. Smith, Brown, and Townsend (**12**, p. 106) state that when taken from young agar cultures the limits of size are 1 to 3 by 0.4 to 1.8 μ and that the majority measure 1.2 to 2.5 by 0.5 to 0.8 μ. Walkden's (**16**) sizes of unstained bodies representing young agar cultures are: 1.2 to 1.5 by 0.5 to 0.6 μ, paired rods 2.8 to 3.0 by 0.5 to 0.6 μ. Ricker (**10**) states that the size limits of the organism, growing on agar, isolated by him from a raspberry gall, are 1 to 1.6 by 0.4 to 0.7 μ and that the size of the majority are 1.1 by 0.5 μ. Really these "average" measurements by different workers are in closer agreement than one should expect. They reveal the almost universal attitude of bacteriological workers of looking upon all normal bacteria as capable of showing only one form and of possessing but one means of reproduction, one in which daughter cells and mother cells are alike except in the long diameter.

Having presented figures showing the diversity of sizes, the next question to be considered is the diversity of forms. From the sizes one may surmise that some of the rods are rather minute, while others are fair sized. But one of the most interesting and characteristic features of the crown-gall organism is the common occurrence of individuals much wider at one end than at the other, giving the appearance of short, stocky clubs. When heated and heavily stained they usually appear homogeneous throughout. Stained by the more delicate, flagella-staining method, they frequently can be seen as plump rods which appear to be distended at one end (see PLATES 24 and 25). This extension comprises the narrow portion of the club and internally is associated with the presence of heavily staining material, reaching from the main body of the rod into the narrow portion (see PLATE 25).

In some of the figures there is a more or less definite suggestion of a nuclear phenomenon occurring at the point of extension or elongation and suggesting, at least in gross appearance, the ordinary budding process of yeast cells. Another interpretation of this is that the main body represents a bacterial spore which is in the process of germination. Lastly, there is the possibility that these extensions represent some abnormal or senility process, in which the old rod is disintegrating, pushing out its contents prior to its death and prior to its final form as a ghost cell. The last explanation need not be entirely overlooked (ghost cells are occasionally observed in young, rapidly growing cultures). That they are not mere artifacts due to the process of mordanting and staining may readily be proved by observing living cultures in hanging drops. When this is done, clubs looking very much like those in stained preparations may be commonly observed, and occasionally there is a strong suggestion in this living material of internal structures comparable to those seen in stained preparations. In addition to the extension from one end of the rod, rods occasionally appear with extensions from both ends (see PLATE 25), and in these figures there is also to be noted an internal, heavily staining mass of material at each end either in the act of pushing out from the end of the rod into the bud or separated into two masses lying close together, one being in the end of the main body and the other in the bud-like extension. These buds vary considerably in size, sometimes being but a mere fraction of the rod and grading into bodies almost as long as the mother cell, and occasionally as wide. Very often they are seen to possess heavily staining bodies at each pole.

As to the internal structure of rods which possess no buds or extensions at the poles, there is to be seen, both in living material and in stained preparations, marked difference in different parts. Stained, they are very frequently seen as more or less lens-shaped bodies, heavily stained at both ends and aside from the wall, which can be definitely seen in this organism (see PLATES 24 and 25), appear perfectly colorless toward the center. These deeply colored bodies are undoubtedly to be interpreted as polar bodies which have been noted in many non-spore-forming bacteria, and whose functions are quite debatable. It is quite probable that it is these bipolar, lens-shaped organisms which Levine takes to be spores. When seen unstained, in hanging drop cultures, the ends as noted above appear different, being more refractive than the centers, but when placed alongside of true bacterial spores, as I had occasion to observe in a mixed culture of *B. tumefaciens* with some large, unknown, peritrichous, spore-forming rod, then the difference between the true spore cell and the cells of *B. tumefaciens* with refractive ends was very marked indeed. The very glistening, round, highly refractive spores and the very slightly refractive and non-glistening ends of the crown-gall pathogene can hardly be considered the same. Spore staining methods used by the writer point to a similar conclusion.

The question of spore formation in this organism is apt to be considered a very important one. If this is a spore former, what is the likelihood of control by washing seedlings and scions for 10 minutes in a 0.25 per cent hydroxymercurichlorophenol solution, and dipping the grafts in this same strength of solution, as Waite and Siegler (15) recommended?[1] In the older literature, and occasionally in more recent articles dealing with phytopathogenic bacteria, there appear statements to the effect that spores appear in the cultures. Thus Burrill (3) described spores for the organism causing sorghum blight, and Manns (9) found spores in old cultures of *Pseudomonas Avenae*, an organism causing the blade blight of oats. Others might be mentioned, but these two well-known diseases and their causal agents are good examples of errors which have crept in, mostly in the older literature. (For a good preliminary description of the sorghum pathogene, see Charlotte Elliott (5) and for the oat organism see (4) by the same author.) Indeed, there is not a single, authenticated, bacterial plant pathogene known to the writer which is known to produce spores. While it is never safe to generalize in such matters, the large number of phytopathogenic bacteria known at present to be non-spore formers makes it unsafe to accept statements to the contrary, unless accompanied by a large amount of unimpeachable evidence. Are there any bacteria, saprophytes or parasites, known to produce spores which are not large-sized organisms? If not (2), what are the possibilities of comparatively short or small-sized rods, characteristic of most and perhaps all plant pathogens, of producing spores? Coupled with this, it will be recalled that all bacterial phytopathogens form a rather compact group, in many respects very closely related, not a single coccus type being definitely known to be a plant pathogene. (In the older literature these are of course recorded, Burrill's *Micrococcus amylovorus*, Prillieux' *Micrococcus* associated with discolored wheat kernels, etc.)

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[1] Spores of the tetanus bacillus are killed only after three hours in a 1 to 1000 mercuric chloride solution, and spores of the anthrax bacillus in two hours in

There is other convincing evidence that spores are not formed in *Bacterium tumefaciens*. The writer has quite often failed to obtain transfers from cultures several months old, the old media being nutrient broth, nutrient agar, and potato glucose agar. Very good evidence can be found in the thermal relationships of this pathogene. Smith and his co-workers (12, p. 120) found it to be killed when exposed for 10 minutes in beef broth at about 51° C. and when exposed on agar or broth for seven days at 37 to 37.4° C., they likewise found it to be dead. Walkden (15) found

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the same strength solution. (The strength is very comparable in killing power to the 0.25 per cent organic mercury solution.)

the thermal death point to be between 44 and 46° C. The writer has obtained similar results. In view of all this evidence, it is safe to conclude that *Bacterium tumefaciens* does not produce spores.

In addition to the ends of the rod and extensions from these showing deeply staining bodies, there is often to be observed a more or less roundish body, sometimes seen as a heavy band, near the centers of medium- or large-sized rods (see upper figure, PLATE 25). Such central bodies have mostly, if not always, been found in rods which show only one polar body. Not infrequently, instead of a solid band, there appear two small bodies opposite each other and also in the equatorial region of the rod (see PLATE 25, middle, right-hand figure). In rods measuring 3 μ or more in length, there is to be noted at times two regions, each representing two particles arranged opposite each other, in various ways suggesting mitotic figures (see large rod in PLATE 25, middle, right-hand figure). However, it would be unwise to insist that these represent true spindles, for the bodies are so tiny that even with the highest magnifications their forms and the connection between them are not clearly discernible. In addition to the one or two bands or pairs of bodies, there are various other figures which suggest a nuclear phenomenon prior to cell division (see upper figure, PLATE 25). Very frequently a cleavage line can be seen separating two heavily stained, closely joined ends and associated with this there is a greater or lesser amount of invagination at this point. A suggested interpretation for this is as follows.

There is a regular nuclear division followed by a cell division in which there is no true cell plate formation, but rather a pushing in or cleavage plane formed, beginning at the outer walls and finally extending clear through the width of the rod. Such a process is of course well known in many fungi, and perhaps in other plants. But, regardless of the true interpretation of these internal bodies, and the writer is certainly far from settled on any one explanation, their presence at the point of division throws considerable burden on those who look upon bacteria as devoid of anything suggesting a true nucleus. The writer has already questioned this assumption in an address delivered before the

Mycological Section of the American Botanical Society (American Assoc. Adv. Sci. meeting at Cincinnati, December, 1924), and expects to discuss this more fully in a later article. I am not absolutely certain that only in rods with a single polar body do such division figures appear, but if this is true can it mean that one or both of the polar particles represent nuclei, one of which moves to the center of the body when it is ready to divide?

ULTRAFILTRATION EXPERIMENTS

The very small-sized rods and buds or extensions derived from larger rods, as previously described, brought up the question of the possibility of filtering these through bacteriological filters. If these minute bodies are alive, could they not pass through a porcelain filter and produce typical growth after such passage? To test this out, a steam-sterilized Berkefeld V filter was used. A 48-hour culture growing in an Erlenmeyer flask containing 350 cc. of nutrient broth, kept at 29° C., was poured into the mantel and a vacuum of about 630 to 711 mm. of mercury utilized for around 20 minutes. The filtrate was then carefully transferred in various quantities by means of sterilized pipettes, the transferring being done in a small, completely enclosed chamber, which had previously been heavily steamed. Transfers were made into tubes of nutrient broth and into petri dishes, to which melted, nutrient agar was added. Contaminations in the form of large rods, in rather rapidly growing, irregular-margined colonies were noted on practically all of the plates and in some of the broth tubes. But thanks to the careful work of Smith and his associates, the plates and tubes, all apparently showing no growth, typical of *B. tumefaciens*, were kept under close observation for over a week. All the plate colonies which appeared within four days after transfer were recognized as contaminations. Beginning with the fourth day, very small, round, glistening, whitish, almost translucent, colonies were noted in small numbers on some of the plates. They grew slowly and remained small, not more than 2 to 4 mm. up to the eighth day. When transferred to nutrient agar slants they made typical growth, though not with the wrinkled appearance which is obtainable in cultures representing numerous previous transfers from various slants.

As there is a possibility of flaws even with the best of filters, the same filter was utilized for filtering a culture of the fire-blight pathogene, *Bacillus amylovorus*. The culture used represents an isolation made by the writer in May, 1925, from a blighted apple and has been previously reported on by the writer (11). As the mature rods of this organism are smaller than those of the crown-gall pathogene, and as no tiny bodies comparable to those found in the latter were observed, it would appear that the use of *B. amylovorus* for ultrafiltration constitutes a very rigid check. Transfers from the filtrate, made in the same way and in the same quantities, were entirely free from *B. amylovorus*.

In addition to transferring part of the filtrate of the crown-gall organism as previously described, the remaining filtered broth was then centrifuged at about 1200 revolutions per minute for 20 minutes, and all but the liquid closest to the bottom of the flasks discarded. This was then examined in hanging drops and in stained preparations. The examinations showed typical short rods, containing the bipolar, heavily staining bodies, in all respects characteristic of *B. tumefaciens*. They were rather few in number, and not a single medium- or large-sized rod was observed. The transfers from the plates on nutrient agar slants were also carefully examined and stained, and the characteristic bud-like processes noted on many of the rods. In all other respects the stained preparations, representing colonies derived from filtered material, were comparable to the typical forms of *B. tumefaciens*.

These filtration experiments, while in a preliminary stage and requiring further work, are of considerable interest not only because they throw some light on the morphology of the crown-gall organism, but also because of their possible application to the work being done on human cancer and that on certain filterable viruses. The recent article by Smith (14) calling attention to work of foreign cancer specialists is worthy of mention. He states that certain German investigators, Ferdinand Blumental and his associates, have isolated a schizomycete from human breast cancers, which in pure culture resembles *B. tumefaciens*. With this organism, together with heated cancerous breast serum and diatomaceous earth, they have been able to cause malignant transplantable tumors in rats and crown-galls in plants. Furthermore, this work has apparently been substantiated by other German workers in another laboratory, Reichert and his co-workers, who have done away with the use of cancer serum as an added irritant and who, using pure cultures of the PM strain of the organism isolated by Blumental and his associates, have been able to produce metastasizing, malignant, transplantable tumors in rats.[2] Along with these findings and apparently in disagreement with them, Smith reports the work of Gye and Barnard of England. The former has been able to cultivate the virus of Rous' chicken sarcoma in test tubes and has obtained numerous infections in chickens by the use of these cultures. In spite of this, the test tube liquid cultures show no observable pellicle, precipitate or clouding, nor is anything visible under the highest powers of the microscope, except when the culture fluid is centrifuged. Then it is that the virus may be found at the bottom of the tubes in a "particulate" form. Gye (7) further reports that two factors are necessary for the production of a tumor; one is the virus and the other some labile chemical substance left in the supernatant liquid of centrifugalized cultures, termed the specific factor. He also reports mouse and rat cancers as being transmissible by a cell-free filtrate and by virus cultures. Human tumors were likewise investigated. When cultures from one of these were inoculated in chickens and the specific factor added, tumors indistinguishable from Rous' chicken sarcoma were obtained.

But Barnard's morphological studies (1) of the viruses isolated by Gye are of particular interest to the writer. He reports that by the use of special light arrangements attached to a microscope he is able to observe the particles constituting the virus and has concluded that they are comparable to the organisms (also filterable) causing bovine pleuro-pneumonia. The latter show sphaeroids on the sides of which small refractive particles are formed, an arrangement which doubtless suggested yeast-like germination, and hence the pathogene was considered a yeast by one or more former investigators. Usually the sphaeroid disintegrates, while some of the particles develop into small sphaeroids, each of which produces attached particles in turn. Considerable observation on infective cultures has led Barnard to conclude that the same type of phenomenon, but on a smaller scale, is to be observed in the Rous' chicken sarcoma, in a mouse sarcoma, and in human carcinoma.

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[2] This is not the first time that investigators have reported finding an organism in human beings which is referable to *B. tumefaciens* and which is capable of producing crown-gall in plants. About eleven years ago, Friedemann and Magnus (6) reported that from the faeces of a sick human they isolated an organism which produced crown-galls in plants.

As the writer has already recorded, *B. tumefaciens* in young vigorously growing cultures produces buds or extensions from the regular rods, often seen as short, plump, lens-shaped bodies, which resemble in various aspects the budding of yeast cells. Is it not a remarkable coincidence that a comparable type of structure should be noted in the crown-gall pathogene and in the virus of various forms of cancer? Also, given a medium which may be better adapted to the growth of these cancer viruses, may not the growths then be heavier and hence more observable? In spite of Dr. Barnard's statement to the contrary, there is that possibility and it can be exemplified in the work of Noguchi on yellow fever, in which a filterable virus is also involved. To the writer the work of Barnard and Gye and that of Blumental and Reichert is not as conflicting as it appears to be.

SUMMARY

I. By means of a special method of staining, developed by the writer, the following observations on *Bacterium tumefaciens* are made. First, a very marked variation in size in young cultures, varying from 0.6 to 3.6 μ in length, and 0.3 to 1.0 μ in width. Second, the presence of many club-shaped rods in young cultures, which appear heavily stained and homogeneous by ordinary staining methods and which are found to consist of plump rods with extensions or buds from one end, by the special staining method. These buds comprise the narrow portions of the clubs and are found to possess a heavily staining interior body which is found extending at first into the main body of the rod. The process is stated to be comparable to the budding of yeasts. Third, the presence of heavily staining, bipolar bodies in ordinary rods. Evidence is presented to show that these rods are not

spores and that no spores are to be expected in this organism. Fourth, a central body found in rods possessing one polar body, the central body being in the form of a band or of two particles opposite each other, suggesting a mitotic figure. Other evidence is presented indicating a nuclear phenomenon prior to cell division.

II. Using a Berkefeld V filter in preliminary experiments, the filtrate is found to contain small rods, which when transferred give rise to characteristic growths of *B. tumefaciens*. Checked with a culture of *Bacillus amylovorus*, a small rod former but possessing no tiny buds or minute rods, the filtrate remained sterile. Attention is called to the bud-like processes described by Barnard as occurring in the virus of various tumors and comparison is made with this and the bud-like extensions on rods of *B. tumefaciens*.

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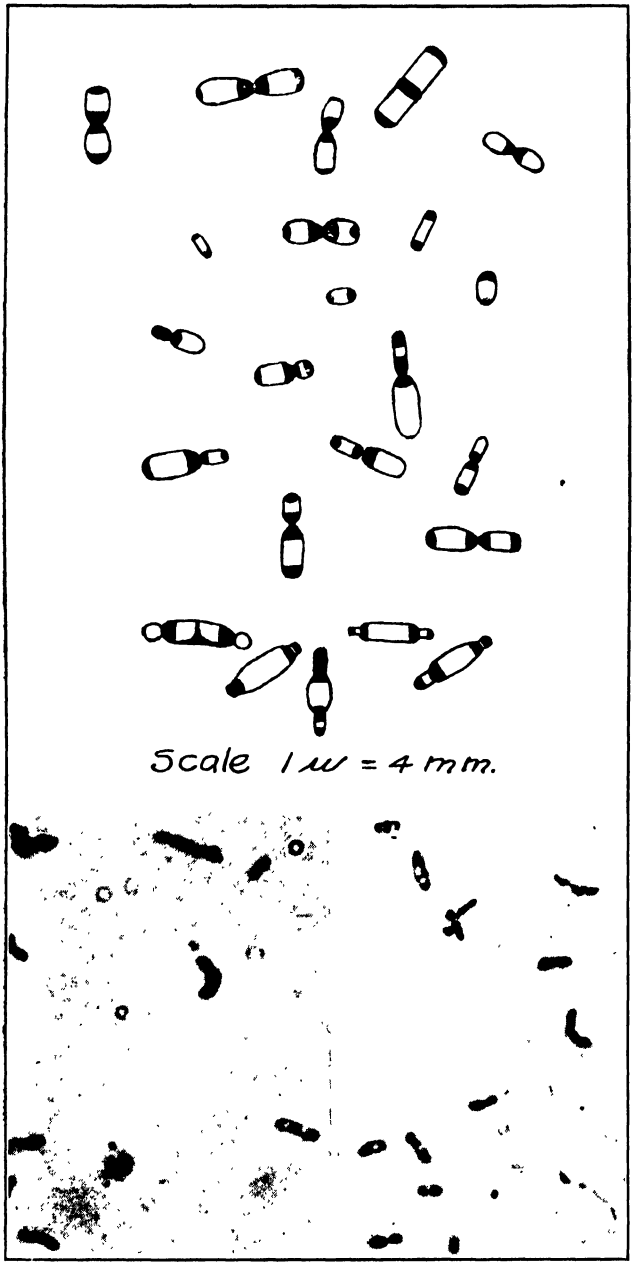

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EXPLANATION OF PLATES

PLATE 24 (upper)

Bacterium tumefaciens stained heavily to show the flagella. Upper two right-hand figures magnified about 1500 times, lower right-hand and upper left-hand figure about 1200 times. While somewhat heavily stained, some stubby club forms may be observed, consisting of a small bud-like process extending from one end of the rod.

PLATE 24 (lower)

B. tumefaciens showing the common bipolar bodies, also bud-like extensions from one end, and heavily staining bodies towards the centers of some of the rods. Upper left-hand figure magnified about 1500 times, the two upper right-hand figures about 1200 times, and the remaining figures about 1000 times.

PLATE 25

Upper figures drawn to scale from stained preparations representing young, vigorously growing nutrient agar cultures. Lenses used 1.5 mm. Zeiss apochromatic objective, and 10 planoscopic ocular. Counterparts of almost all the figures can be seen in the photomicrographs of the previous plates and some on this plate. For explanation of various figures, see text.

Lower figures showing bipolar bodies, buds or extensions from the ends (especially lower right-hand figure), central bodies suggesting mitotic figures (middle right-hand figure), and the extremely small size of some of the rods (note the tiny rod with the flagellum in the lower left-hand figure, and compare this in size with the bipolar rod to the right). Magnified about 2000 times.

TWO SPECIES OF PHYSALOSPORA ON CITRUS AND OTHER HOSTS

NEIL E. STEVENS

(WITH 2 TEXT FIGURES)

The following discussion of two species of *Physalospora* known to occur in the tropics forms a part of our studies of those fungi whose pycnidial stages are commonly referred to the genera *Diplodia* and *Sphaeropsis*. It is published in the hope that it may stimulate further collecting of these fungi, particularly their perfect stages, by investigators who are located in or may visit tropical countries.

A PHYSALOSPORA WITH BROWN ASCOSPORES

To place in the genus *Physalospora* a fungus with colored ascospores is of course to do violence to the established ideas of that genus. A careful study of the fungus about to be described is sufficient, however, to convince even the most sceptical that it is genetically related to *Physalospora malorum*. This fact furnishes further evidence that such distinctions as spore color in the separation of genera are in some cases highly artificial.

The fungus under consideration was collected by the writer on cut branches of cultivated *Citrus* at Herradura, Cuba, during January, 1925, and a few days earlier on cut branches of unidentified hosts, certainly not *Citrus*, at Santa Lucia Bay and Cape San Antonio, Cuba. The perithecia of this fungus are usually 225 to 250 μ in diameter, and are scattered singly in the bark of the host. When cut across, especially before the spores are fully mature, the contents have the snow white appearance which is so characteristic of the genera *Botryosphaeria* and *Physalospora* and which makes these fungi so easy to distinguish and collect. When the ascospores are mature, however, they are brown in color and the center of the perithecium then appears dark even under the hand lens (FIGURE 1, *A*) though the paraphyses and the surrounding tissue of the perithecium still remain white. Perithecia

ASCOSPORE MEASUREMENTS OF *Physalospora* SPECIES

TABLE I. LENGTHS

	Number of Spores Having a Given Length in Microns																			
	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	Total
P. fusca						9	15	14	16	16	14	13	2	1						100
P. rhodina (from *Persea*)		3	2	2	9	18	18	12	11	11	7	2	1	1	1	1	1			100
P. rhodina (from *Gossypium*, *Hicoria*, *Ilex*, *Liquidambar*, *Quercus*, and *Vitis*. See (1) p. 197)	3	19	13	33	32	32	91	46	138	94	70	99	54	32	15	3	9	2	2	787

TABLE II. WIDTHS

	Number of Spores Having a Given Width in Microns											
	7	8	9	10	11	12	13	14	15	16	17	Total
P. fusca					1	5	35	43	14	2		100
P. rhodina (from *Persea*)				6	14	16	31	24	6	3		100
P. rhodina (from six hosts)	1	10	31	90	115	194	159	109	67	10	1	787

TABLE III. RATIOS OF LENGTH TO WIDTH

	Number of Spores Having a Given Ratio of Length to Width							
	2	2.5	3	3.5	4	4.5	5	Total
P. fusca	29	69	2					100
P. rhodina (from *Persea*)	34	55	11					100
P. rhodina (from six hosts)	92	418	219	40	14	3	1	787

of a species of *Physalospora* having white ascospores are shown in "B" and of a species of *Botryosphaeria* (probably *B. Ribis*) in "C." Both these specimens are on avocado (*Persea*) and were collected in Cuba during January, 1925.

Asci of the brown spored *Physalospora* measure from 120 to 150 microns in length and are typically eight-spored (see FIGURE 2, *F* and *G*). The ascospores are one-celled, brown, and measure, as shown by TABLES I–III, 29–37 × 11–16 μ, mostly (more than half) 31–34 × 13–14 μ. The ascospores of this fungus are readily distinguished from those of any other known species of the genus by their brown color.

Under the conditions of our culture work the germination of these ascospores is of the same type as that described and illustrated for *P. malorum* and other species of the genus,[1] that is, a single germ tube is produced which develops to many times the length of the spore before it branches (**10**). Pycnospores were readily produced in the single ascospore cultures under the conditions described in our earlier papers (**10** and **13**). As will be apparent (FIGURE 1, *D* and *E*, and TABLES IV–VI) the pycnospores are very similar indeed to those of "*Diplodia gossypina*" and to those of the *Citrus* stem-end rot fungus which has usually been called *Diplodia natalensis*. The pycnospores of all three species when young are unicellular and hyaline with a thick wall; they later become dark colored, generally uniseptate and the wall shows characteristic irregular longitudinal grooves or markings. The measurements given in TABLES IV–VI show that pycnospores of the brown spored *Physalospora* agree closely in size and appearance with those which have been called "*D. natalensis*" and "*D. gossypina*." There is, however, some variation in the size of the pycnospores of all of these fungi, the significance of which is not yet evident but which may be associated with the host or the condition of growth. With the information now available at least it is apparently not practicable to distinguish the pycnospore stages of these fungi.

Since no fungus at all corresponding to the brown spored

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[1] Most of the papers to which reference is made are cited in "The Life History and Relationships of *Diplodia gossypina*." Mycologia **17**: 191–201, 1925, by the writer, and the numbers given in this text are those in the list of literature at the end of that paper.

PYCNOSPORE MEASUREMENTS OF *Physalospora* SPECIES

TABLE IV. LENGTHS

	Number of Spores per Hundred Having a Given Length in Microns														
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
P. fusca	4	4	22	28	14	13	12	2	1						
P. rhodina (from *Citrus*)	1	3	12	8	12	18	11	14	7	5	8	1			
P. rhodina (from *Melia*)	3	4	12	22	25	24	6	2	1		1				
P. rhodina (from *Persea*)			2	2	2	6	25	19	28	10	4	2			
P. rhodina (from *Gossypium*)	2	3	6	7	7	16	14	15	8	7	10	3	1	1	

TABLE V. WIDTHS

	Number of Spores per Hundred Having a Given Width in Microns								
	10	11	12	13	14	15	16	17	18
P. fusca		11	37	33	12	6	1		
P. rhodina (from *Citrus*)		4	24	29	13	18	11	1	
P. rhodina (from *Melia*)	6	20	32	30	10	2			
P. rhodina (from *Persea*)			4	24	30	28	14		
P. rhodina (from *Gossypium*)	1	1	10	28	28	22	5	4	1

Physalospora here described can be found in the literature, the writer is under the necessity of designating it as a new species, *Physalospora fusca*.

Physalospora fusca sp. nov.

Type specimen (No. *1003*) collected on *Citrus* at Herradura, Cuba. January 1925.

Pycnidia simple or compound; pycnidial stromata black, 1 × 2 mm. in diameter; pycnospores at first one-celled and hyaline, becoming dark brown and septate, usually with irregular longitudinal striations, 20–28 × 11–16 μ, mostly (more than half) 23–25 × 12–13 μ.

Perithecia scattered to gregarious, black externally, 225–250 μ in diameter; asci typically eight-spored, clavate, 120–150 μ long; ascospores one-celled; 29–37 × 11–16 μ, mostly (more than half) 31–34 × 13–14 μ, brown when mature.

THE PERFECT STAGE OF THE CITRUS STEM-END ROT DIPLODIA

That the perfect stage of the *Citrus* stem-end rot *Diplodia* is a *Physalospora* closely related to *P. malorum* was proven about a year ago (13). The ascospore material secured on *Citrus* at that time was too scanty to permit adequate description of the fungus. During a short collecting trip in Cuba in January, 1925, however, the writer obtained abundant ascospore material of this fungus on avocado (*Persea*) and *Rosa* sp. at Santiago de las Vegas. From a study of this material it appears that the perithecia of this species average about 300 to 250 μ in diameter, are scattered singly in the bark and show in section the same snow white appearance as those of *P. malorum*. (See FIGURE 1, *B*.) Asci of this species measure from 90 to 120 μ in length and are 20–25 μ in width at the widest place. They are typically eight-spored though in some specimens asci containing but four spores are by no means rare. Ascospores are one-celled, hyaline and, as shown (TABLES I–III), those from *Persea* measured 25–40 × 10–16 μ, the largest number being 30 × 13 μ. The pycnospores, as shown (TABLES IV–VI, and FIGURE 1, *D*), agree closely in size and appearance with those of *P. fusca*.

Smaller numbers of ascospores were obtained from rose but those measured were of much the same size as those on avocado, the largest number being 31 × 11 μ in size. The fungi from these two hosts agreed in all cultural characters including good growth at 37° C. and the chromogenesis on potato dextrose agar at this temperature.

Comparison of the spore measurements given in TABLES I to VI and of the plates in this and the earlier paper show that the species of *Physalospora* common on cotton, oak, and other hosts in the southeastern United States and the one here discussed on avocado and rose are so similar in both their perithecial and pycnidial stages as not to be clearly separable by morphological characters. Hitherto the writer has been inclined to confine the name *Diplodia natalensis* to the form which grew readily at 36–37° C. and showed chromogenesis on potato dextrose agar at that temperature, because that seemed to be the most common in the cultures from rotten citrous fruit from Florida turned over to him for study by Fulton and Winston (13), and because Fawcett[2] in his careful studies of the temperature relations of "*Diplodia natalensis*" also had the high temperature form.

Not all the cultures of "*Diplodia*" from *Citrus* and other hosts which are able to grow at 36–37° C., however, show chromogenesis at this temperature. Moreover, the low temperature form is now known to occur on *Citrus* as well as other hosts. Among the collections made on *Citrus* by the writer at Santiago de las Vegas, Cuba, was a *Physalospora* which would not grow at temperatures above 32° C. yet agreed in all morphological characters with the high temperature form and produced pycnospores indistinguishable from those which we have hitherto called *D. natalensis* and *D. gossypina*.

Moreover, Fulton reports (unpublished material) varying percentages of the "low temperature form" in cultures from decayed citrous fruit. These are no doubt largely the fungus having hyaline ascospores and common on many hosts, though it is of course possible that *P. fusca*, which also does not grow above 32° C., may cause decay of citrous fruit in the regions where it occurs. Further study may even prove that *P. fusca* occurs in

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[2] **Fawcett, H. S.**—The temperature relations of growth in certain parasitic fungi. University of California Publications in Agricultural Sciences **4**: 183–232. 1924.

South Africa and that in describing *D. natalensis* Pole Evans may have been dealing with the pycnidial stage of *P. fusca*.

In view of these facts, the wisest course at present seems to be to consider the high temperature fungus merely as a variety, and to consider as a single species the material which is common on many hosts and apparently indistinguishable on morphological grounds.

Since many of the species of *Physalospora* hitherto described in this country have little to distinguish them except the hosts on which they were collected and since we now know that certain species at least are common to many hosts, the name to be applied to the material here considered must be chosen more or less arbitrarily.

Physalospora rhodina (Berk. & Curt.) Cooke agrees well in morphological characters with the fungus which we are studying. It was collected on rose by M. A. Curtis in a part of North Carolina where our fungus is common on many hosts. This name will accordingly be applied to the fungus under consideration.

PHYSALOSPORA RHODINA (Berk. & Curt.) Cooke, Grevillea 17: 92.

Type specimen collected by M. A. Curtis on *Rosa rubiginosa* in North Carolina. In Herb. Cooke, Kew.

Synonyms. It is not possible to give even an approximately complete synonymy at this time but the name is here used to include *Diplodia natalensis* as used by Fawcett and other American investigators, as well as *Physalospora gossypina* and *Diplodia gossypina* of our earlier papers.

Pycnidia simple or compound, varying in size and complexity with the bark of the host, from 1 to 6 or 7 mm. in diameter; pycnospores at first one-celled and hyaline, becoming dark brown and septate usually with irregular longitudinal striations; 20–33 μ × 10–18 μ, mostly (more than half) 24–28 μ × 12–15 μ.

Perithecia gregarious, black, 250–300 μ in diameter; asci typically eight-spored, 90–120 μ long, ascospores hyaline; 24–42 × 7–17 μ, mostly 30–35 × 11–14 μ.

CULTURAL CHARACTERS OF THE TWO SPECIES

On many culture media *P. fusca* and *P. rhodina* are very similar in appearance. Under the conditions of our work, however, in which the cultures are kept in a well-ventilated greenhouse where the temperature varies from 55–60° F. to 85–90° F. and the humidity is fairly high, due to the regular watering of the green plants which occupy about two thirds of the space,

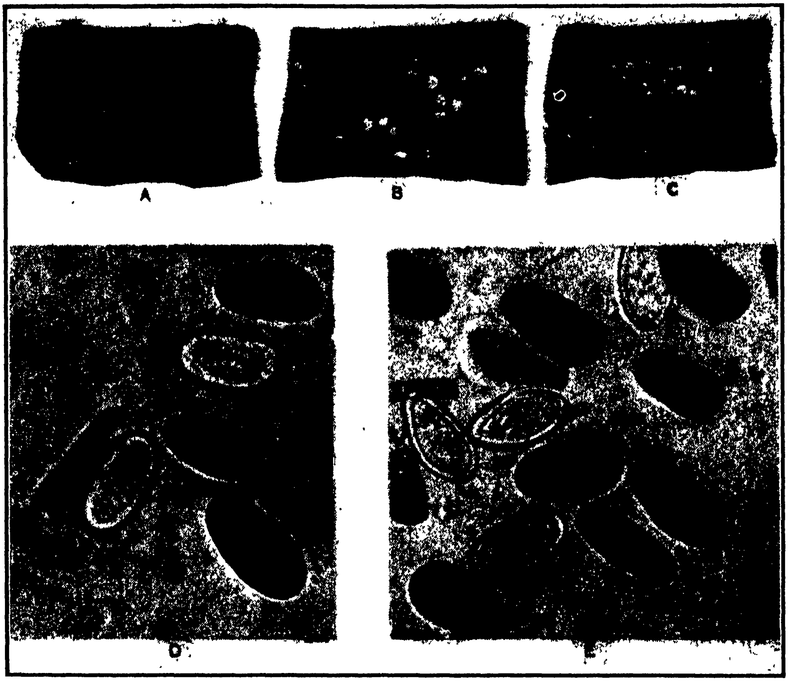


FIG. 1. A, cut perithecia of *Physalospora fusca* on *Citrus;* B, *Physalospora rhodina* on avocado (*Persea*); C, *Botryosphaeria* sp. (probably *Botryosphaeria Ribis*) on *Persea*. × 8; D, pycnospores of *Physalospora rhodina* produced in culture from single ascospores; E, pycnospores of *Physalospora fusca* produced in culture from single ascospores. × 520.

P. fusca has fruited earlier and more abundantly than *P. rhodina*. On corn meal in flasks both species produce what Earle and Rogers call "stromatic masses," that is, little mounds of mycelium in which the pycnidia are borne. These masses, however, are much smaller and more evenly distributed in *P. fusca* than in *P. rhodina* so that in mature fruiting cultures on corn-meal flasks, usually four to six weeks old, *P. fusca* much more resembles *P. malorum* than *P. rhodina*. (FIGURE 1, *D* and *E*.)

HOST RELATIONS OF THE SPECIES OF PHYSALOSPORA

No one of the species of *Physalospora* now recognized appears to be confined to a single host. We have collected *P. malorum* on over twenty host species, *P. rhodina* on nine host species and *P. fusca* on at least two. The relatively much smaller number of hosts on which the latter species have been found is very likely due to the smaller number of collections it has been possible to make. What seems to be the pycnidial stage of *P. rhodina* has, as will be pointed out below, a wide distribution both geographically and in its host relationships. So far as the writer has been able to determine from a study of the literature and from personal conversations it is the unanimous opinion of those who have studied the tropical and subtropical species of "*Diplodia*" in the field that they are not confined to particular host species but may occur on a great variety of hosts.

PHYSALOSPORA AND BOTRYOSPHAERIA ON CITRUS AND ROSA

The difficulty of identifying and satisfactorily studying the species of *Physalospora* is greatly increased by the fact that, as just mentioned, no one of the species now recognized is restricted to a single host, and in many cases two species are known to occur on the same host. For example, all three of the species of *Physalospora* which we have studied have been found on *Citrus*. *P. malorum* was collected on *Citrus* by Fulton in Alabama, *P. rhodina* by Stevens at Satsuma, Florida, and Santiago de las Vegas, Cuba, and *P. fusca* at Herradura, Cuba. At least one species of *Botryosphaeria* also occurs on *Citrus*, as the writer has received from Bowman a culture isolated from a rotten orange from California which proves to be a *Botryosphaeria* very similar to *B. Ribis*.

Somewhat similar conditions apparently obtain on many hosts. For example, we already have both *P. rhodina* and *P. malorum* on rose and some time ago found that *Botryosphaeria Ribis chromogena* not only occurred on but caused a disease of certain varieties of rose.

TABLE VI. RATIOS OF LENGTH TO WIDTH (PYCNOSPORES)

	Number of Spores per Hundred Having a Given Ratio of Length to Width			
	1.5	2	2.5	3
P. fusca	28	70	2	
P. rhodina (from *Citrus*)	19	81		
P. rhodina (from *Melia*)	4	92	4	
P. rhodina (from *Persea*)	30	70		
P. rhodina (from *Gossypium*)	31	59	10	

TABLE VII

LIST OF SPECIMENS OF *Diplodia* WHICH HAVE BEEN RECEIVED FROM OUTSIDE THE UNITED STATES, AND WHICH AGREE WITH *P. rhodina* IN THE CHARACTER OF THEIR PYCNOSPORES, IN THEIR ABILITY TO GROW AT 37° C. AND TO TURN POTATO DEXTROSE AGAR RED OR PINK AT THAT TEMPERATURE

Number	Host	Locality	Collector	Average Size of Pycnospores from Host	Average Size of Pycnospores in Pure Cultures
190	*Mangifera indica*	Poona, India	S. L. Ajrekar	19.6 × 11.9	22.6 × 12.8
191	*Albizzia*	" "	" " "	19.5 × 11.1	21.1 × 12.0
216	Sweet potato tuber	Pusa, India	F. J. F. Shaw	22.8 × 13.6	23.3 × 12.6
220	*Cajanus indicus*	Trinidad	F. Stell		27.8 × 14.0
227	Young tea plant	Peradeniya, Ceylon	T. Petch	20.9 × 11.4	24.3 × 12.5
228	Pod of *Hevea brasiliensis*	" "	" "	23.6 × 13.7	27.0 × 14.1
231	Diseased bark of *H. brasiliensis*	" "	" "	23.4 × 13.1	27.4 × 13.8
234	*Cinnamonium zeylanicum*	Southern Province, Ceylon	" "	25.0 × 13.9	32.7 × 12.9
260	Lime twigs	Trinidad	F. Stell		27.8 × 14.6
290	*Grevillea* seedling	Uganda. Africa	W. Small		29.6 × 13.6
305	Cocoa pod	Federated Malay States	A. Thompson		27.9 × 13.7
306	" "	" " "	" "		28.4 × 14.6
308	*Hibiscus*	" " "	" "		28.5 × 14.0
410	Strawberry fruits (*Fragaria*)	Santiago de las Vegas, Cuba	B. O. Dodge		27.0 × 13.5

THE PROBABLE DISTRIBUTION OF PHYSALOSPORA RHODINA

In view of the close similarity of the pycnidial stages of *P. rhodina* and *P. fusca*, the writer would hesitate to attempt the identification of any of these species from dry pycnospore material alone. As suggesting, however, the distribution of *P. rhodina* it may be well to record the host and locality from which we have received viable material for study (TABLE VII). Many of these specimens or cultures have been received through the courtesy of Dr. E. J. Butler, of the Imperial Bureau of Mycology.

Only those fungi are here listed which grew readily in culture at 37° C. and turned potato dextrose agar pink at this temperature, a characteristic of one form of *P. rhodina* common in Florida and Cuba. The pycnospore measurements given are simple averages of the measurements of ten apparently normal spores.

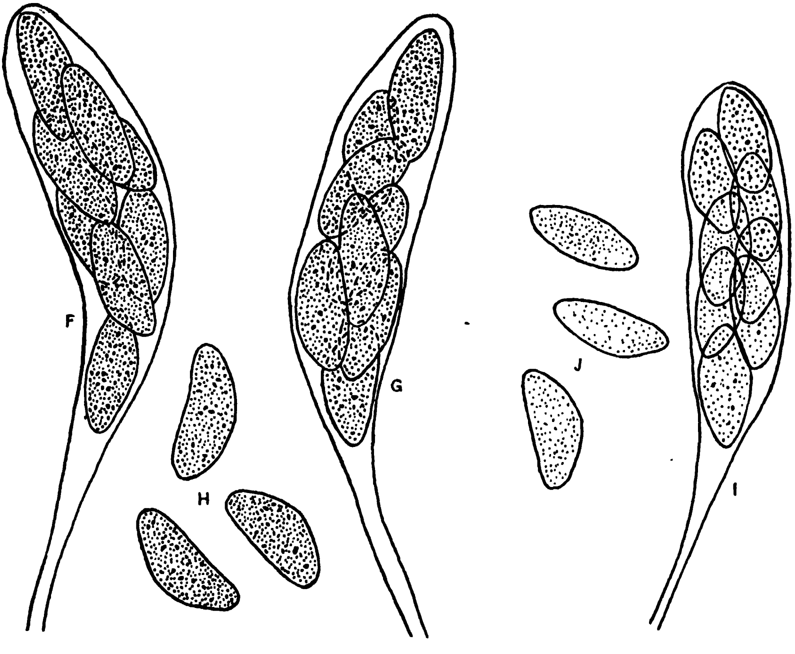


FIG. 2. F & G, asci of *Physalospora fusca;* H, ascospores of *Physalospora fusca;* I, ascus of *Physalospora rhodina;* J, ascospores of *Physalospora rhodina.* × 420.

In view of the fact that we were dealing with pycnidial material only, it did not seem worth while to measure large numbers.

What significance the variation in size of the spores from different host species or the difference between spores grown on the host and those grown in culture from the same material may have, the writer is as yet unable to say.

Whether, as seems possible, the *Diplodia* so generally parasitic on *Hevea* and *Cacao*, usually designated as *Diplodia cacaoicola*, is identical, at least in part, with *P. rhodina* can be determined only by careful comparative study. In view of the economic importance of these fungi such a study should not be long delayed.

SUMMARY

A species of *Physalospora* found on *Citrus* and other hosts in Cuba is described as *Physalospora fusca*. *P. fusca* is distinguished from other known species of the genus in having brown ascospores.

The perfect stage of the fungus which has usually been called *Diplodia natalensis* in this country is apparently identical with *Physalospora rhodina* (Berk. & Curt.) Cooke.

Physalospora gossypina as used in our earlier papers is apparently a synonym of *P. rhodina*.

What is apparently the pycnidial stage of *P. rhodina* has been received from various localities outside the United States.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

SOME FLORIDA FUNGI

AMY G. WEEDON

(WITH PLATE 26 AND 2 TEXT FIGURES)

The fungi herein described were collected by the author during a short visit to St. Petersburg, Florida, during the winter of 1923. The vicinity abounded in fungi, but time and opportunity permitted of only a small collection. Specimens of all species are deposited in the herbarium of the University of Illinois.

Hysterographium Cocos Weedon, sp. nov.

The hysterothecia appear as small black excrescences upon diseased spots of leaves, gregarious, 0.25–1 mm. long, black, carbonaceous, erumpent, superficial; opening by a long, narrow slit; asci 88–77 × 10 μ, 8-spored, spores hyaline at first, becoming dark when mature; muriform, 3–5 transverse septa with numerous longitudinal walls, 14–17 × 7–10 μ, slightly larger at one end than at the other. Paraphyses present.

On *Cocos Alphonsei*, St. Petersburg, Florida, Feb. 15, 1923, No. *4* (type).

ELLISIODOTHIS INQUINANS (Ellis & Ev.) Theiss. Ann. Myc. **12**: 73. 1914.

Asterina inquinans Ellis & Ev. Jour. Myc. **3**: 41. 1887.

Asterula inquinans Theiss. Ann. Myc. **10**: 193. 1912.

On *Sabal Palmetto*, St. Petersburg, Florida, Feb. 15, 1923, No. *3*.

This specimen agrees in all respects with the description given by Theissen, also with the specimen of Ellis and Everhart in the North American Fungi, Second Series, No. *1785*, labeled *Asterina inquinans*.

Myriangium Sabaleos Weedon, sp. nov.

The stromata appear as small, black, slightly raised excrescences, 0.1–0.5 mm. in diameter; perithecia immersed, becoming erumpent, 300–900 × 230–300 μ; asci 95 × 18–21 μ, 8-spored; spores muriform, 3–5 transverse septa and 2–3 longitudinal walls, 21–25 × 7 μ.

On *Sabal Palmetto*, St. Petersburg, Florida, Feb. 15, 1923, No. *2* (type).

The black excrescences are surrounded by a pale zone, 1–2 mm. in diameter. The spots are visible from both sides of the leaf. The asci when first released are incased in a tough sheath, forming almost spherical bodies, 24–27 × 25–28 μ. These sheaths are frequently found in the *Myriangiaceae.*

CHAETOTHYRIUM HAWAIIENSE Mendoza.

On *Citrus decumana*, St. Petersburg, Florida, Mar. 30, 1923, No. *10.*

This specimen resembles sufficiently the type specimen of *C. hawaiiense* to be considered identical with it. The fungus on the type specimen, *Morinda citrifolia*, is very scanty in amount while that on my specimen is profuse, forming a thick, sooty coating over the entire leaf. Associated with this Florida specimen are many long, stalked, beaked pycnidia. No conidia were found. Mendoza (Bull. Bishop Museum, 1925) discusses and illustrates a similar pycnidium in his description of *Antennellina hawaiiensis.*

Didymella Cocos Weedon, sp. nov.

Spots irregular in size, 3–30 × 2–5 mm. or by coalescing into long streaks which run the length of the leaf; black, epiphyllous. Perithecia scattered, carbonaceous, erumpent, 234–312 μ in diameter. Asci clavate, hyaline, 52–60 × 8–10 μ, 8-spored; paraphyses filiform, 53–70 μ long. Spores 10–14 × 3.5 μ, hyaline, guttulate, 1-septate.

On leaves of *Cocos Alphonsei* associated with *Hysterographium Cocos*, St. Petersburg, Florida, Feb. 15, 1923, No. *6* (type).

Young spots are small, and black throughout. As they get older they become ashen in the center and are surrounded by a black border 2–3 mm. wide. The tissue without the border and especially on the margin of the leaf is frequently rose colored. Spots may be visible from both sides of the leaf. Perithecia are most abundant in the ashen centers of the spots. They are for the most part on the upper surface of the leaf. The spores are slightly constricted in the middle where there is a distinct septum, the ends are attenuated. Four guttulae are present. The lines between the guttulae give the appearance of septa, so that the spores on casual observation appear to be three-septate. It is the opinion of the writer that there is really but one septum, in which case this species would fall in the genus *Didymella*. If, however, there are three it would fall in the genus *Metasphaeria*.

Saccardo cites three species of *Metasphaeria* on *Cocos: Metasphaeria cocogena* (Cooke) Sacc. In this he says the spores are in two rows, tritorulosis, ends pointed, 20 × 10 μ, probably 2-septate. The specimen in question does not have spores in two rows, and they are somewhat smaller. "*Metasphaeria ? Spegazzinii* Sacc. & Trott." differs widely, the asci measuring 100 × 16–18 μ, and being aparaphysate. The third, *Metasphaeria Cocoës* Petch, does not agree either, asci being 260 × 15 μ, the spores fusoid and 85–100 × 5 μ.

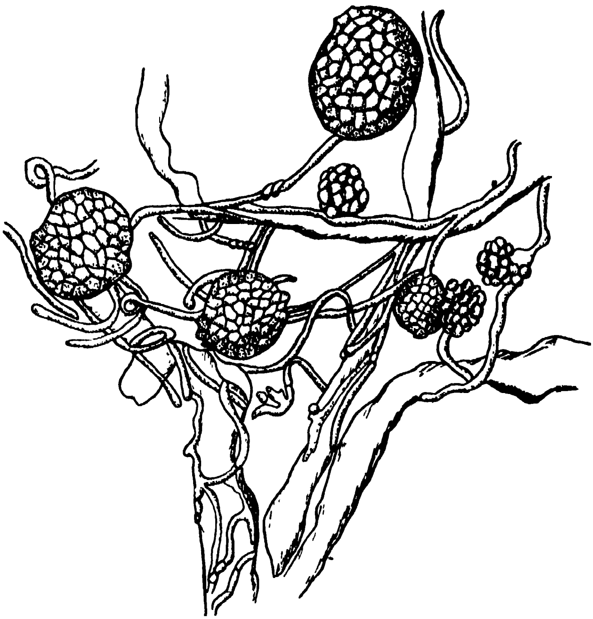


FIG. 1. *Exophoma Magnoliae*, pycnidia in various stages of development and mycelium upon trichomes of *Magnolia grandiflora*.

UROMYCES BIDENTIS Lagh.

On *Bidens* sp., St. Petersburg, Florida, Mar. 7, 1923, No. *8*.

This specimen agrees with the description given by Sydow in the Monographia Uredinearum 2: 3. 1910.

Exophoma Weedon, gen. nov.

Mycelium superficial, fuscous, not dematioid, not gelatinous. Pycnidia carbonaceous, free, superficial, sessile, ostiolate. Conidia hyaline, continuous.

Exophoma Magnoliae Weedon, sp. nov.

Colonies 1–3 mm. in diameter, scattered superficially on the under leaf surface or forming large, gray, mottled areas, covering the greater part of the leaf. Mycelium fuscous, branched, occasionally very slightly beaded, 3.5–5 μ thick. Young pycnidia greenish brown, becoming carbonaceous at maturity when they measure 35–53 μ in diamater; ostioles slightly papillate or cleft, 7–21 μ in diameter. Conidia hyaline, continuous, 3.5 × 1 μ.

On *Magnolia grandiflora*, St. Petersburg, Florida, Feb. 15, 1923, No. *5* (type). (TEXT FIGS. 1, 2.)

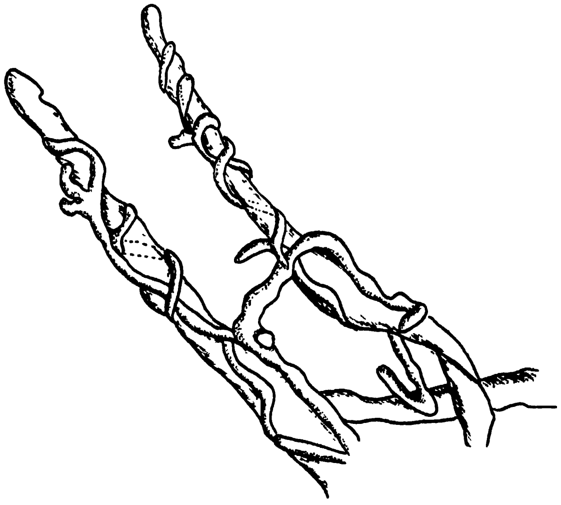


FIG. 2. *Exophoma Magnoliae*, trichomes of *Magnolia grandiflora* entwined with mycelium.

The mycelium and pycnidia suggesting relationship with the Perisporiaceae indicate that the fungus may be the imperfect stage of one of this family. It is entirely superficial, forming a meshwork upon the trichomes, upon which it may twine loosely or heavily encrust. The vegetative mycelium is slightly lighter in color than that bearing pycnidia.

Macrophomopsis Stevens & Baechler, gen. nov.

Like *Macrophoma* but with paraphyses.

Macrophomopsis Dracaenae Stevens & Baechler, sp. nov.

Spot brown, involving a large area of the leaf. Pycnidia 155–180 μ, numerous, black, immersed, ostiolate, erumpent. Spores 22–25 × 3–14 μ, one-celled, hyaline. Paraphyses 38–55 μ in length.

On *Dracaena* sp., Guahiles, Costa Rica, July 18, 1923, No. *508*. The specimen is deposited in the herbarium of the University of Illinois.

On *Iris* sp. (cultivated), St. Petersburg, Florida, Mar. 30, 1923, No. *9*.

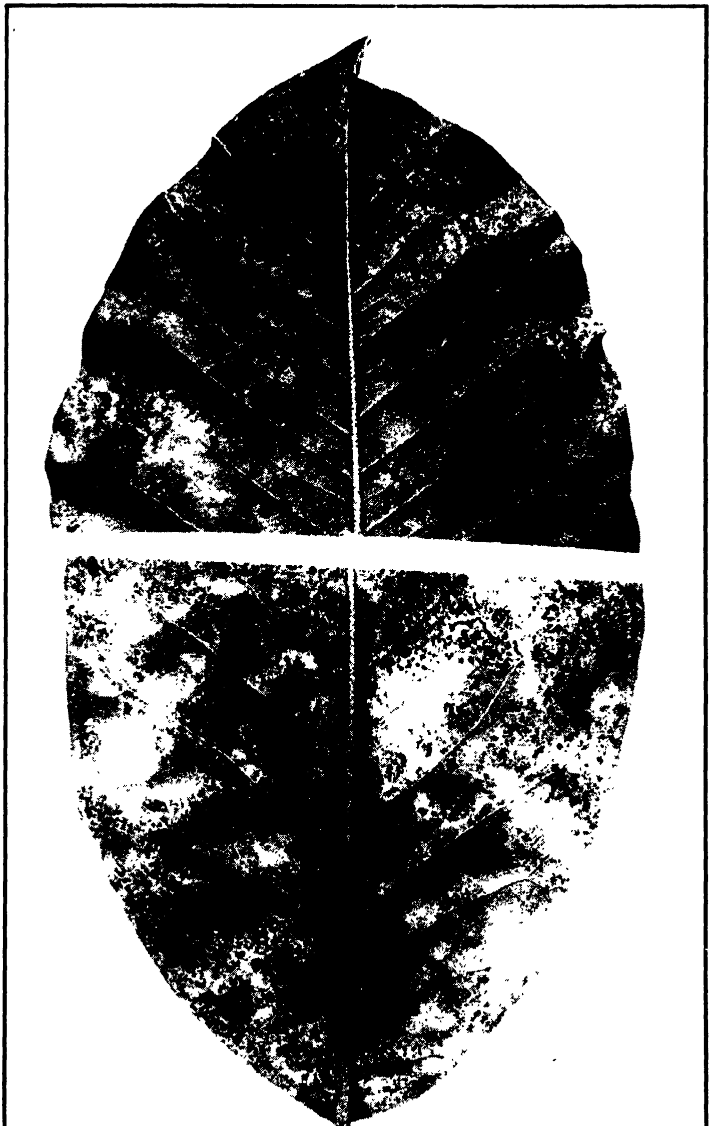
This specimen agrees identically with one found recently in Guahiles, Costa Rica and described as a new genus and species by Stevens and Baechler. Their description follows:

On crushing open a pycnidium spores of all sizes up to the maximum are found and their connection with their conidiophores is clearly evident. Between the conidiophores arise the long, slender, comparatively straight paraphyses which distinguish the genus. The characters of this fungus as well as the name suggest similarity with *Phomopsis* but the paraphyses here do not fall away as do the "stylophores" in *Phomopsis*, but remain always attached.

Heterosporium Magnoliae Weedon, sp. nov.

Colonies brownish-black, irregularly circular, 0.5–1 cm. in diameter, or consisting of large, irregular areas covering practically the entire under surface of the leaf, or scattered in bead-like, short chains, straight to circular in outline. Mycelium superficial, smooth, branched, fuscous. Conidiophores suberect, branched, echinulate, darker than mycelium, approximately 400–850 × 15–23 μ. Conidia vary greatly in size, from 14–53 × 3.5–5 μ; 1–5 or 7 septa; echinulate. (PLATE 26.)

On *Magnolia grandiflora*, St. Petersburg, Florida, Feb. 15, 1923, No. *1* (type).



HETEROSPORIUM MAGNOLIAE

This fungus differs from the typical *Heterosporium* in being superficial and perhaps for that reason should be regarded as a separate genus.

GRAPHIOLA PHOENICIS (Moug.) Poit. Ann. Sci. Nat. I. **3**: 473. 1824.

On *Phoenix dactylifera*, St. Petersburg, Florida, Mar. 8, 1923, No. 7.

This specimen agrees in all respects with the description given by Saccardo.

NORTH AMERICAN SPECIES OF SCLEROTINIA—I[1]

H. H. WHETZEL

(WITH PLATES 27–29 AND 1 TEXT FIGURE)

Some ten years ago the writer agreed to undertake the preparation of a monograph on the species of *Sclerotinia* for the North American Flora published by The New York Botanical Garden. A survey of the species reported from North America up to that time led the writer to assume that the undertaking would be a relatively simple one. His limited experience in taxonomic work was also doubtless an important factor in luring him into what promises to be a long and laborious though a most interesting and enjoyable investigation.

It soon became apparent that to prepare a careful and reliable presentation of the North American species in this genus would require not only the collection and the examination in fresh condition of the morphology of as many of the forms as possible but also a comparative study of these forms in pure culture. Collecting soon uncovered undescribed species of *Sclerotinia* and species not heretofore reported from this country. The numbers of these have now increased to such an extent and the results of our field observations and culture work have presented so many new facts that a radical revision of the plans with respect to the work seems necessary.

It now appears desirable, before attempting preparation of the manuscript for the flora, to present a series of studies on groups of related species and on certain problems arising during the course of the investigations. It is proposed to publish these papers as rapidly as possible detailing our investigations with results and conclusions. No attempt will be made to present these studies in any logical sequence. Each paper will constitute a unit in itself and they will appear in the order in which the work on each subject is completed.

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[1] The investigations upon which this paper is based were supported by a grant from the Heckscher Foundation for the Advancement of Research established by August Heckscher at Cornell University. The writer wishes to acknowledge also the assistance of Miss Christine Berkhout and Miss Cynthia Westcott, who as Heckscher Research Assistants have materially contributed to the success of these investigations. The photographs were taken by W. R. Fisher; the drawing was made by Miss Westcott.

While these studies are fundamentally mycological it is perhaps our phytopathological bias which impels us to include, along with the usual morphologic and taxonomic data ordinarily comprising such monographic studies, a consideration of the life history, pathogenic effects on the suscept and cultural characters of the various species treated, in so far as our observations on these features permit. It is proposed to illustrate each species more or less fully with photographs and drawings. Previous work on the species, at least the more important papers, will be cited.

It is hoped that the presentation of these studies will stimulate greater interest among mycologists and plant pathologists in a genus of fungi all the species of which appear to be pathogenic and some of which are at least of marked economic importance. The cooperation of our colleagues both in this country and abroad is solicited. Specimens, cultures, and observations on any species of *Sclerotinia* will be especially welcome.

SPECIES ON *ERYTHRONIUM*

One of the first species to arouse our interest in the genus *Sclerotinia* was that described by Clements years ago as associated with *Erythronium albidum* in Nebraska. On a visit to the University of Nebraska in 1918 the writer examined with much interest the type material in the herbarium there and made some notes on it. The peculiar little furcate sclerotia were especially intriguing. The discovery of a form similar in many respects to *S. gracilis* Clements and associated with *Erythronium americanum* in New York has afforded the stimulus for an investigation of the forms occurring on *Erythronium*.

SCLEROTINIA GRACILIS Clements; Bessey in Webber, App. Cat. Fl. Nebr. ed. 2. 47. 1892.

This species appears to be the only *Sclerotinia* heretofore described as associated with *Erythronium*. Through the kindness of Dr. Leva B. Walker of the Botanical Department of the University of Nebraska, we have had the opportunity to make a critical examination of Clements' type specimens and his notes and drawings. There is on the herbarium sheet in addition to the brief technical description (published by Bessey in 1892) a penciled memorandum in Clements' hand giving the reason which led him to the conclusion that his fungus had not been theretofore described. There is also a very careful pencil sketch of the apothecia and sclerotium as well as detailed drawings of asci, ascospores and paraphyses.

DESCRIPTION OF SCLEROTINIA GRACILIS CLEMENTS

It seems desirable to present here in full the description and notes just as they appear in Clements' hand on the herbarium sheet together with a photograph of the drawings (PLATE 27, FIG. 5).

"*Sclerotinia.* Cup thin, hemispherical, bright brown, margin entire, darker; stipe elongated, flexuous, thick, 1½ to 2 cm. long; asci cylindrical, attenuated at base, 150–160 × 10 μ; sporidia 8, oblong elliptical, curved, biguttulate, 26–32 × 10–11 μ; paraphyses filiform, slightly clavate at apex, somewhat branched."

"In shady woods (associated with *Erythronium albidum?*). The cups are from 2½ to 3½ mm. broad, a single stipe arising from each of the 2–3 forks of the sclerotium. Sclerotium black, thin, coriaceous, forked, ⅓ × 1½ cm."

"As Saccardo has observed no order in the arrangement of the species of *Sclerotinia*, it is impossible to say just where the specimen in hand ought to be placed."

"The species which the specimen approaches nearest are *Sclerotinia Kerneri* Wettst., *Sclerotinia baccarum* Schröt., and *Sclerotinia megalospora* Woron."

"From *Sclerotinia Kerneri* the specimen in hand is taken out by the stipe, which is at least 10 times as long, by the fact that the spores are much longer and, at the same time, more slender; by the biguttulate spores and by the sclerotium; from *S. baccarum*, it differs in the size of the cup (1⅓–½ as large), in length of stipe (only 1/5 as long), in the shape and chiefly in the size of spores, in having biguttulate spores, in the character of the asci and in the character and features of the sclerotium."

"From the peculiar sclerotium and from the large size of the spores, particularly, it seems almost certain that this must be an unrecorded species."

The label on the herbarium sheet bears the following data in Dr. Bessey's handwriting.

Sclerotinia gracilis Clements in Contrib. Bot. Dept. Univ. of Nebr. Coll. May 12, 1892. Near Lincoln. (Raymond).[2]

The type specimen on the sheet consists of two apothecia but no sclerotia. A part of this type in the Durand Discomycete Collection at Cornell University consists of a single apothecium attached to one fork of the furcate sclerotium. As far as known these represent the only specimens of this collection in American herbaria. Dr. Clements writes us (Nov. 23, 1925) that a specimen was sent to J. B. Ellis at the time the fungus was under investigation but we have not been able to locate this specimen.

Examination of a single mount from the margin of one of the apothecia of Clements' type material shows the asci, spores and paraphyses to agree in general with the above description in Clements' notes. Our measurements of 50 asci however give limits of 191–250 × 9–14.5 μ with 215.7 × 12.5 μ as the mean and 216 × 12.8 μ as the mode.[3] This it will be seen is considerably larger than the measurements given by Clements who may not have measured the full length of the ascus. Fifty spore measurements give limits of 21–29.7 × 7–9.6 μ with 23.7 × 8 μ as the mean and a mode of 21.8 × 7.8 μ, which is somewhat smaller than that recorded by Clements. Our measurements were, however, of necessity largely those of spores still in the ascus and from dried material.

NOTES.—It is highly desirable that further search be made for this fungus by collectors in the range of the host. There are in the Durand herbarium two collections (*719* and *1318*) bearing the name *Sclerotinia gracilis* Clem. both taken about Ithaca, N. Y. In the Atkinson Collection, Cornell University, are two specimens also taken near Ithaca and bearing the name *S. gracilis* Clements, as determined by Durand. A duplicate of one of the Atkinson specimens, *14961*, is also to be found in the Durand Collection under his No. *2233*. All of these are reported as taken on the ground or under leaves. No mention is made of their association with *Erythronium*. None of these show furcate sclerotia and all appear to agree in every respect with *S. Erythroniae* described below.

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[2] Miss Walker advises me that Raymond is a little village near Lincoln in the vicinity of which the collection was made. Clements himself appears to have been the collector.

[3] Mounted in 1 per cent potassium hydroxide solution.

SCLEROTINIA ERYTHRONIAE Whetzel.

On May 7, 1921, Mr. E. E. Honey and Mr. Frank Dickson, then students in our laboratory, collected a *Sclerotinia* near Tulley, N. Y. (C. U.[4] *11530*). The apothecia were taken in some abundance on a wooded hillside to the south of the swamp surrounding Labrador Lake. The cups were found protruding from the soil of little knolls in this hardwood forest. The stipes arose from rather slender fusiform sclerotia buried to a depth of one to five inches in the firm soil (PLATE 27, FIG. 2). No clue to the host plant involved was obtained.

During May of the same year and of some of the succeeding years small apothecia of similar character were collected in this and other localities near Ithaca, but from flat more or less circular or ovate sclerotia (PLATE 27, FIG. 3) lying on the surface of the soil or leaf mold under fallen leaves of the previous season (C. U. *11560* and *14761*). Cultures from these all gave on potato agar similar flat ovate or circular thin sclerotia which resembled those of certain *Botrytis* species except that they were thinner and more flattened.

On May 27, 1923, diseased leaves of *Erythronium americanum* were collected in a wood near Ellis Hollow, N. Y. Tissue plantings were made from the lesions. These gave pure cultures of a fungus forming flat black sclerotia (PLATE 29, FIG. 11). They looked much like the sclerotia of a *Botrytis* and were so labeled and filed. No conidia however ever appeared in the cultures.

On May 16, 1925, a collection (C. U. *14189*) of the apothecia arising from the deeply buried fusiform sclerotia was again made by Mr. Honey and the writer (PLATE 27, FIG. 1) from the same wooded hillside at Labrador Lake as those of May 7, 1921. This time careful examination of the all but completely decayed debris in which the sclerotia were imbedded together with critical observations on the surrounding spring flowers convinced us that the decaying tissues were very probably those of *Erythronium americanum*. On June 1 the writer made a second trip to this locality and all about the spot where the apothecia had been collected two weeks before, the leaves of *Erythronium* were specked with small necrotic lesions which were apparently causing the yellowing and dying of the plants. In some cases these flecks had developed into large water-soaked areas involving a large part or all of the leaf. The petioles in such cases were soft and shrivelling far into the soil. The bulbs however at this time were still firm and apparently healthy. Cultures from the diseased leaves (C. U. *14762*) brought into the laboratory gave mycelium and sclerotia typical of those obtained from ascospore sowings. Leaves allowed to rot in a moist chamber formed many flat black sclerotia which gave cultures typical of those from ascospores.

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[4] Specimens deposited in the current herbarium of the Department of Plant Pathology of Cornell University will be designated with the abbreviation C. U. to distinguish them from the completed collections such as the Atkinson herbarium, the Durand Discomycete herbarium, etc., now deposited in our general herbarium.

Comparison was then made of our various cultures previously obtained from *Erythronium* leaves and from unknown apothecia arising from flat sclerotia from forest soil with the result that the above reported forms when brought together proved to be so much alike as to suggest a common identity. Further comparison of cultures on standard media convinced us that all belonged to the one species, the apothecial form of which was first collected in 1921 by Honey and Dickson. The apothecial stage (C. U. *15145*) was collected in abundance in the Lloyd Preserve at McLean, N. Y. in 1926 and at Forest Home near Ithaca, N. Y. (C. U. *1564*).

The only species of *Sclerotinia* heretofore recorded as occurring in association with *Erythronium* appears to be *S. gracilis* of Clements reported from Nebraska. He found his species, however, associated with *Erythronium albidum*. Comparison of our species with his specimens and description shows it probably to be distinct.

LIFE HISTORY.—The evidence upon which the following outline of the life history of *S. Erythroniae* is based is largely circumstantial but it is believed to be substantially correct. The apothecia appear about the time the leaves of the host are full grown, in the type locality, during late April and throughout May.

The discharged ascospores fall on the leaf blades and infect them. The infections on the leaf blades are at first minute necrotic spots surrounded by a definite dark green zone (PLATE 28, FIG. 7). The leaves look speckled. The mycelium gradually spreads throughout the leaf causing a degeneration of the chlorophyl with a resulting yellowing of the leaf about the green-zoned lesions. The tissues become water soaked, then dry out becoming dirty brown and papery, finally shrivelling and falling over on the soil. The fungus spreads down the petiole, invades the bulbs and forms the typical fusiform black sclerotia. Irregularly ovate flat sclerotia, usually small in size, are formed in the rotting leaf blades on wet soil.

In the spring a single apothecium, rarely two, arises from each sclerotium. Those from sclerotia formed in the underground organs force their way up through the soil, often from a depth of five inches (PLATE 27, FIG. 2) to open and expand the cup just at the surface of the soil so that at first sight they appear to be almost sessile. Those arising from sclerotia formed in the leaves are short stalked. Infected leaves are usually abundant within a week or ten days after the apothecia appear. Ascospores discharged on the leaves of entire plants in a moist chamber and on plants in the open gave typical lesions in 4 days (PLATE 28, FIG. 7).

CULTURAL CHARACTERS.[5]—Grown on potato agar, oat agar and

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[5] Standard media prepared as follows have been used in all culture work with these Sclerotinias:

POTATO AGAR.—Water (tap) 1 liter, agar shreds 18 grams, glucose 10 grams, 2 average sized potatoes, peeled, sliced and boiled in the water until tender. The glucose and agar shreds are added to the potato bouillon after it is filtered. The mixture is then autoclaved or held in a steam cooker until the agar is dissolved. The sediment is then settled out in a large funnel held in a steam cooker. After hardening the sedimented apex of the cone is cut away and the clear agar remelted and tubed or put in small flasks for pouring plates.

OAT AGAR.—Water (tap) 1 liter, Quaker Rolled Oats 35 grams, agar shreds nutrient agar, this species exhibits the following characteristics. Only sclerotia and microconidia are produced, the latter appearing sporadically on all the media especially in old cultures on potato agar, the former only on the potato and oat agar. Small aborted sclerotia appear rarely on nutrient agar in test tube slants. On nutrient agar the fungus causes a strong discoloration of the medium giving it a dirty reddish-brown color when held against a white background and growth is relatively slow compared with that on the other two media. Sclerotia are generally larger but fewer on oat agar than on potato agar (PLATE 29, FIG. 11–12), strikingly so in petri dish cultures.

The sclerotia produced in culture are like those formed in the rotting leaves but are decidedly different in form from that which they assume in the host organs in the soil. In general they are more or less circular in outline like those produced in the infected leaf blades, averaging around 3 to 5 mm. in diameter though frequently very small ones, 1 mm. in diameter, are produced. Along the margins of the test tube slants and about the margins of the petri dish cultures elongated fused sclerotia are commonly formed next to the glass (PLATE 29, FIG. 15). There is also some tendency for the sclerotia on the surface of the slant or plate to fuse (PLATE 29, FIG. 10, 12 and 16). The distribution pattern on potato agar is indefinite, that is, the sclerotia are not arranged in any definite order but are irregularly scattered over the surface (PLATE 29, FIG. 11 and 13). On the oat agar, especially in petri dish cultures, the sclerotia are commonly more or less zonate in arrangement (PLATE 29, FIG. 10 and 12). The sclerotia in normal cultures are deep black, dull, that is, scarcely or not at all polished, thin and flat or slightly convex. They are usually superficial but are sometimes immersed in the media particularly in petri dish cultures on potato agar. No appressoria have been observed and no conidial structures other than the microconidia already referred to are produced. The microconidia are typical of *Sclerotinia*.

14 grams. The oats are steeped for half an hour in water, the agar shreds added and held in autoclave or steam cooker until melted. The sediment is then settled out as above described.

NUTRIENT AGAR.—Water (distilled) 1 liter, Leibig's beef extract 3 grams, peptone 5 grams, agar shreds 14 grams. These are heated together until the agar is melted and then filtered through filter paper or absorbent cotton.

In old strains, that is, those that have been carried in culture for several years, the sclerotia tend to form slowly as compared with recently isolated cultures. They are usually larger, less abundant and remain flesh colored for a long time, often failing to completely color, the black or brown color appearing only around the edge of the sclerotium, the center remaining white or flesh colored and often decked with a distinct white hyphal weft (PLATE 29, FIG. 14).

Sclerotinia Erythroniae Whetzel, n. sp.

Apothecia slightly elevated above the surface of the soil, 3–5 mm. broad, cupulate to broadly shallow saucer shaped, finally flat or convex with reflexed margins, fleshy (PLATE 27, FIGS. 1, 2 and PLATE 28, FIG. 6). Inside of disc at first Prout's brown (R.[6]) becoming a dark seal brown (R.[6]) with age; under surface lighter colored. Stipes often very long up to 5 or 10 cm. (PLATE 27, FIGS. 1 and 2), about 1 mm. at base of the cup and gradually attenuated toward the sclerotium, tough. Arising from deeply buried, usually more or less pointed black sclerotia, to which they are firmly attached, or from flat, ovate sclerotia in leaf mold on the surface of the soil in which case the stipes are short (PLATE 27, FIG. 3).

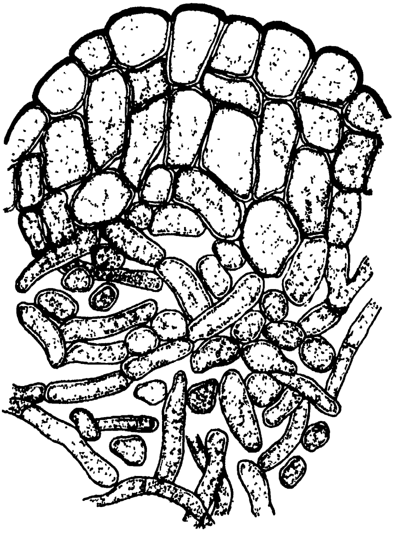

FIG. 1. Cross section of a portion of the sclerotium from the type strain (C. U. *14189*) showing structure of medulla and rind.

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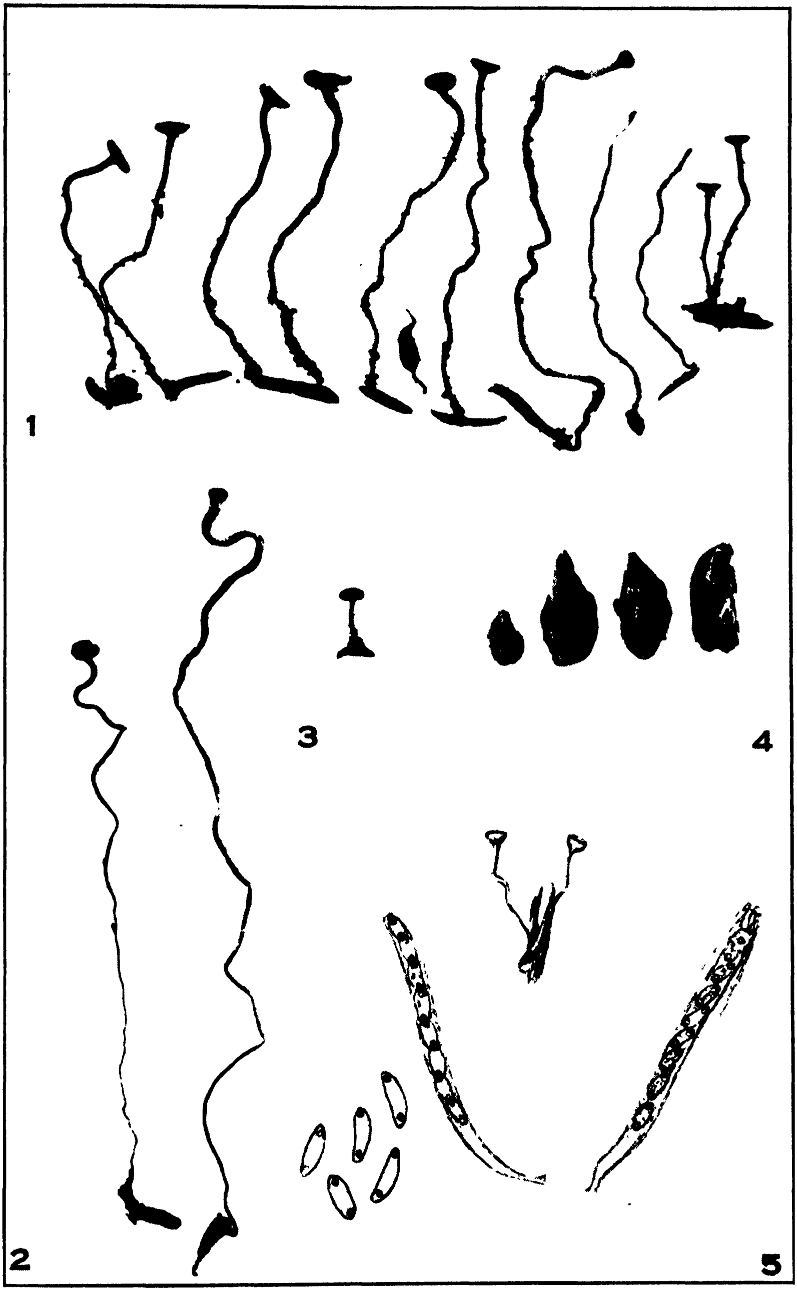
[6] R. = Ridgway's Color Chart.



Sclerotinia

Asci cylindric, attenuated toward the base. One hundred measurements give limits of 200–275 × 10–15 μ, mode 250 × 12 μ, mean 240 × 12 μ. Ascospores long elliptical, rarely inequilateral, often guttulate, one hundred measurements give limits of 20–30 × 7–10 μ, mode 25 × 8.8 μ, mean 25 × 8 μ. Paraphyses slender filiform of nearly uniform thickness throughout, or slightly swollen toward the apex.

Microconidia have been observed only in culture (PLATE 28, FIG. 9).

Sclerotia formed in the bulbs and root stalks, simple (never branched or furcate), 5–10 mm. long, in cross section broadly loaf shaped, more or less irregular in outline, 1–1½ mm. in diameter; becoming deeply furrowed lengthwise with exhaustion of stored food, as apothecia develop; flat, irregularly circular or ovate when formed in the leaves or in culture. Structure consisting of a rather loose hyphal white medulla of uniform density, surrounded by a rather distinct rind of several layers of rather large isodiametric cells forming a pseudoparenchymatous layer, the external walls of the outer cells of which are thickened and black (TEXT FIG. 1).

Occurring among colonies of the host plant on shaded knolls or wooded hillsides, April–May; parasitic on *Erythronium americanum* Ker. Type locality Labrador Lake, near Tulley, N. Y. Common in all localities about Ithaca where sought. Not known from elsewhere.

HERBARIUM MATERIAL.—Type, Cornell Dept. Plant Pathology Herb. *14189*. Other collections in the same herbarium are *11530* and *11560* (apothecia), *12484* (diseased leaves), *14761* (apothecia), *14762* (diseased leaves), *15145* and *15164* (apothecia). In the Atkinson (Cornell Univ.) Collection are *14961* and *1787* (apothecia) and in the Durand (Cornell University) Discomycete Collection *1318* and *719* (apothecia), all labeled *S. gracilis* as determined by Durand, but undoubtedly *S. Erythroniae*.

NOTES.—While our species is no doubt closely related to *S. gracilis* Clements it exhibits certain very distinct characters especially in the form of the sclerotia which in hundreds of specimens examined have never been observed to be forked as in *S. gracilis*. The apothecia are apparently larger and more fleshy. The asci and the spores are both somewhat larger. It may here be remarked that apothecial characters are much less diagnostic in the genus *Sclerotinia* than are the sclerotia. Its parasitic habit on a different species of *Erythronium* from that of *S. gracilis* is also to be regarded as suggesting its specific identity. Comparative studies in pure culture together with cross inoculation experiments with the two species will alone determine with certainty whether they are distinct. As opportunity for us to make such studies does not appear probable in the near future it seems best on the basis of the data at hand to consider them distinct for the present.

CORNELL UNIVERSITY,
ITHACA, N. Y.

EXPLANATION OF PLATE 27

MORPHOLOGY OF *Sclerotinia Erythroniae* AND *S. gracilis*

1. Apothecia of *S. Erythroniae*, natural size, from sclerotia naturally formed in the bulbs of *E. americanum*. C. U. *14189.*

2. Apothecia of *S. Erythroniae*, natural size, showing extreme depth to which sclerotia may be buried. C. U. *11530.*

3. Apothecium of *S. Erythroniae*, natural size, arising from flat sclerotium formed in leaf on surface of soil. C. U. *14761.*

4. Sclerotia of *S. Erythroniae* formed in pure culture on steam-sterilized bulbs of *E. americanum*. Natural size. C. U. *14762.*

5. *S. gracilis*. Photograph of Clements' sketch of the type specimens in Herbarium Dept. Botany Univ. Nebraska. Natural size. Note the furcate sclerotium.

EXPLANATION OF PLATE 28

HOST RELATIONS OF *Sclerotinia Erythroniae*

6. Young apothecia with husks of rotted bulbs still attached to two of them. The two apothecia on the left are from sclerotia formed in the leaf blade. Natural size. C. U. *15145.*

7. Leaf lesions resulting from inoculation with ascospores shot from apothecia. Natural size. C. U. *15145.*

8. Sclerotia of *S. Erythroniae* forming on the recently infected young rhizomes. The petioles by way of which the fungus entered the old bulbs have rotted away. Natural size. C. U. *15145.*

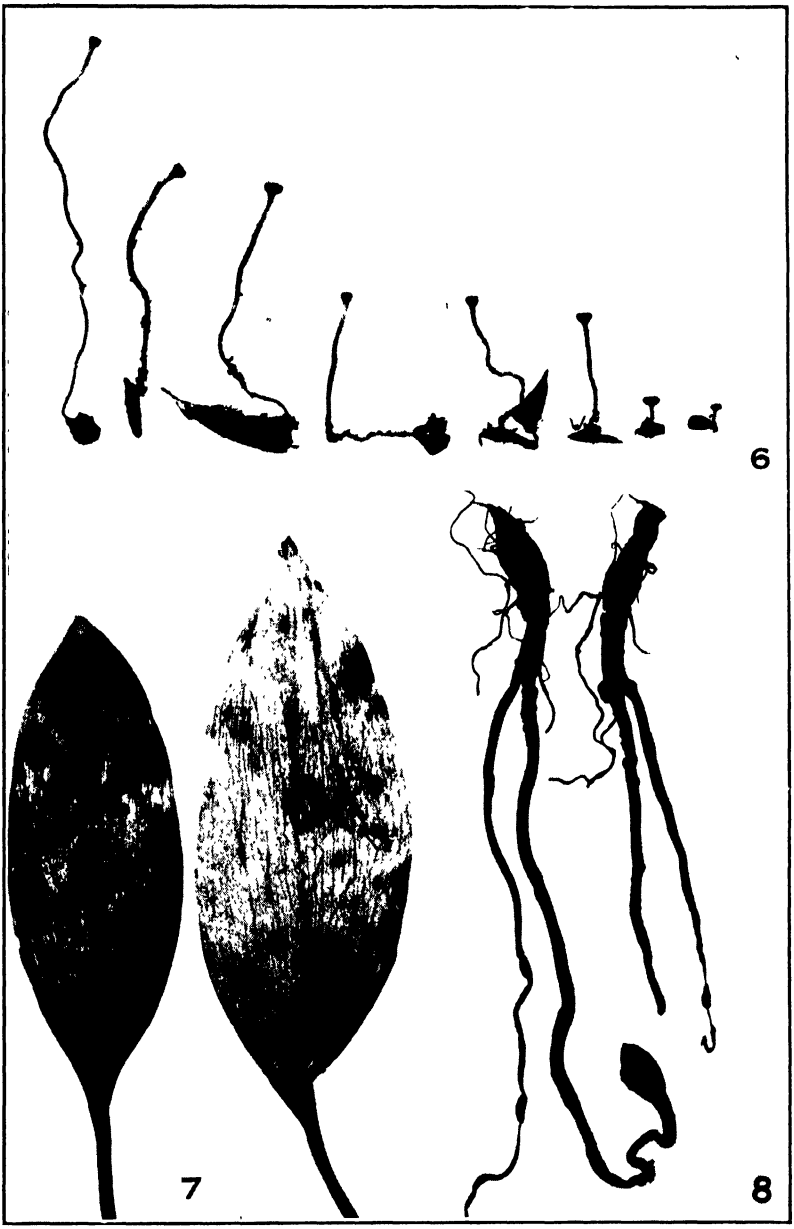
EXPLANATION OF PLATE 29

CULTURAL CHARACTERS OF *S. Erythroniae*

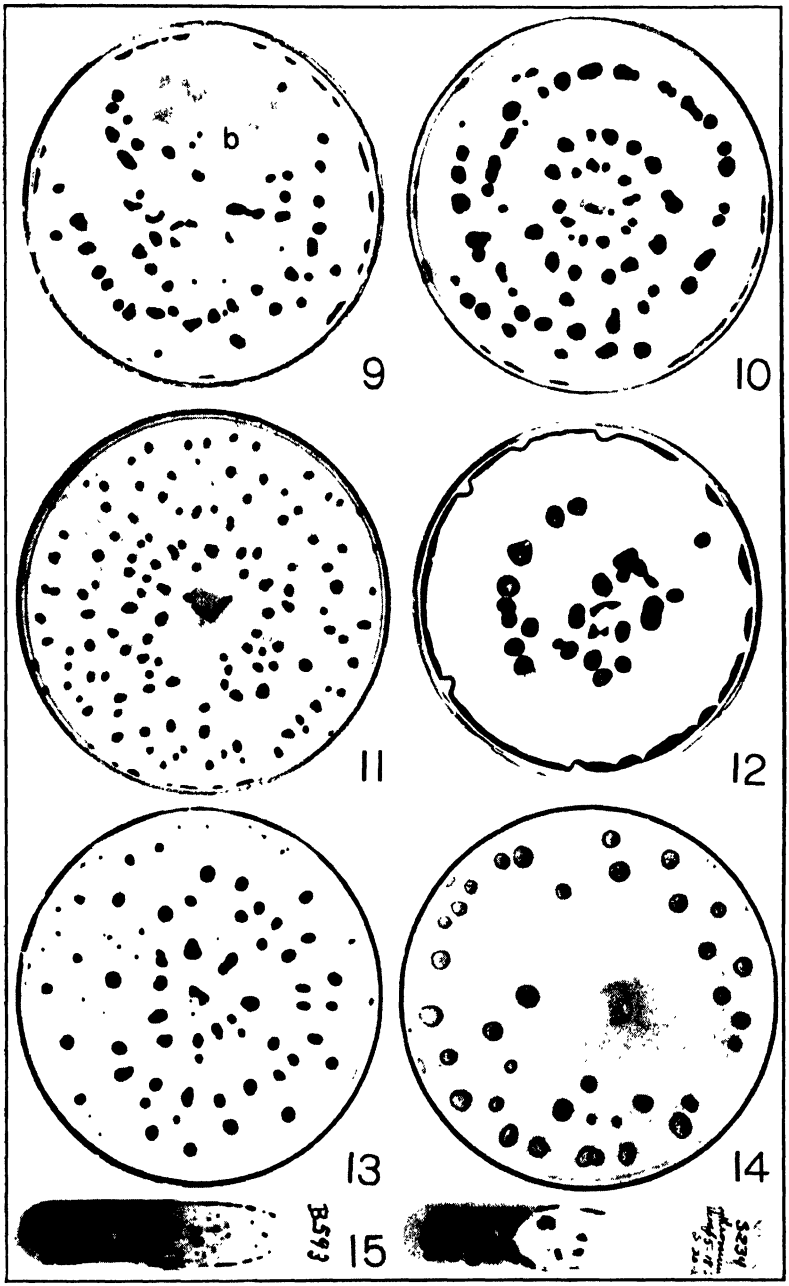
9. Original culture on potato agar from ascospores, about 3 months old. Note the abundant production of microconidia at left above b; b is a bacterial contamination; ¼ natural size. C. U. *14189.*

10. Culture of the same strain on oat agar, 3 months old. Microconidial masses appear as minute specks in the agar; ¼ natural size. C. U. *14189.*

11. Culture of strain isolated by tissue plantings from infected leaf; on potato agar, 20 days old; ¼ natural size. C. U. *12484.*



SCLEROTINIA



CULTURES OF SCLEROTINIA

12. The same strain on oat agar, 20 days old. Sclerotia just maturing; ¼ natural size. C. U. *12484.*

13. Pure culture of ascospore strain from apothecium, fig. 3; on potato agar; 3 months old; ¼ natural size. C. U. *14761.*

14. Pure culture of ascospore strain isolated in 1921; on potato agar, 20 days old. Note the hyphal weft covering the uncolored centers of the sclerotia. Sclerotia often fail to mature normally in strains kept in continuous culture for several years; ¼ natural size. C. U. *11530.*

15. Potato agar slant culture of same strain as in figs. 11 and 12, 6 weeks old; ¼ natural size. C. U. *12484.*

16. Potato agar slant culture same strain as in figs. 9 and 10, about 6 weeks old; ¼ natural size. C. U. *14189.* (Lower right-hand corner. Number omitted.)

NEW AND NOTEWORTHY FUNGI—IV[1]

JOHN DEARNESS

DISCOMYCETES

(Including Phacidiaceae and Hypodermataceae)

Pezizella minuta sp. nov.

Apothecia amphigenous, chiefly on the inner side of the needles, scattered, minute, .2–.4 mm., sessile, based in the hypoderm, at first closed then urn-shaped and finally nearly flat-dish-shaped, spreading and honey-colored when moist, incurved when dry; exciple weak, pale-brown, not quite smooth, ends of 2–3 μ thick hyphae projecting; hypothecium prosenchymatic. Asci cylindric to subclavate, nearly sessile, 8-spored, 36–60 × 8 μ; paraphyses abundant, shorter than the mature asci, 2 μ wide. Sporidia hyaline, obliquely uniseriate or partly biseriate, continuous, elliptic, 6–8 × 3½–5 μ.

On sered ends or large portions of living needles of *Pinus rigida*, Avery Creek, Pisgah, N. C., July 8, 1925. G. G. Hedgcock: *11922*.[2] *P. virginiana*, Andrews, N. C. G. G. H.: *11963*. *P. echinata*, Davidson River, N. C. G. G. H.: *24395*. *P. Taeda*, Elijay, Ga. G. G. H.: *43003*. (D: *5905*.)

The affected tissues become gray-brown and very brittle. It is a question whether the *Pezizella* does not always grow upon needles weakened or killed by other fungi particularly *Hypoderma lethale*. A *Gloeosporium*, spores 6 × 4 μ, is often present, affinity undetermined.

Pezizella ontariensis Rehm, also on pine needles, is externally similar but its sporidia are linear.

(?) DASYSCYPHA FUSCOSANGUINEA Rehm.

Parasitic on branches of *Pinus monticola* Dougl., Boundary Co., Idaho, July, 1924. J. S. Boyce: *1452*. (D: *5727*.)

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[1] I, MYCOLOGIA **8**: 98–107. 1916.
II, " **9**: 345–364. 1917.
III, " **16**: 143–176. 1924.

[2] Dr. Hedgcock's serial numbers in this paper are those of the respective collections placed in the herbarium of the U. S. Bureau of Plant Industry, Washington, D. C.

"Producing cankers on trees of all ages, most severe on saplings up to 20–30 ft., sometimes killing them outright; often attacking the leader and then successive leading branches and producing a deformed or stunted tree"—J. S. B. Cankers hypertrophy the branches from 1½ to 2 times their normal thickness.

This, compared with material collected by Lagerberg on *P. silvestris* in Sweden, labeled as above and passed upon by Rehm, is paler externally, more luteous on the disk and has longer paraphyses, but on the whole is very similar. It is hardly fuscosanguineous and if it is the same species as the European one it must be much more destructive by inference from Rehm's statement of habitat "an durren aestchen"—on dry branchlets.

Marginal hairs yellow-brown, up to 160 × 4½ μ, asci to 115 × 9 μ, sporidia obliquely 1-ranked, spindle-form, 15–18 × 5–8 μ.

PHACIDIUM INFESTANS Karst. var. **Abietis** var. nov.

On leaves of *Abies concolor*, White Pine, Ore., June, 1913. J. R. Weir. Also on blighted leaves among green ones of *Abies grandis*, Lincoln Co., Mont., alt. 2900 ft., July, 1924. J. S. Boyce: *1247*. (D: *5673*.)

For comparison, I am indebted to Dr. Weir for probably authentic European material of the type on *Pinus silvestris*. The variety on *Abies* differs in not being scattered and amphigenous but strictly hypophyllous and in lineal series on each side of the midrib. The sporidia of the var., 16–23 × 6–7 μ, are smaller than the measurements, 22–35 × 8–9 μ, of Karsten's description. Exceptional sporidia in J. S. B.'s *1247* are septate. For interesting observations on the parasitism of the variety by Dr. Weir, see Phytopathology **6**: 413–4.

Phacidium abietinellum sp. nov.

Apothecia hypophyllous, the ruptured epidermis not adnate but remaining as a lid or border, .5–.75 mm., 170 μ deep; the floor 100 μ thick, the side wall of similar tissue but darker and thinner; under the hand lens not distinguishable from the preceding species. Asci 62–75 × 12–13 μ, cylindric or somewhat narrowing downwards; paraphysate. Sporidia hyaline, continuous, globose to broad-elliptic, 6–8 × 5–6½ μ.

On blighted needles among green ones of *Abies balsamea*, Newcombe, N. Y., Aug. 22, 1924. C. R. Orton & L. O. Overholts: *9713.* (D: *5748.*)

Ph. abietinum Kunze & Schm. dehisces with four similar laciniae and, *fide* Rehm's Zur Kenntniss der Discomyceten, p. 124, has sporidia 15–17 × 4–5 μ.

PHACIDIUM BALSAMEAE Davis.

Stegopezizella balsamea Sydow.

Causing blight of leaves of *Abies lasiocarpa*, Uncompaghre Mtns., Colo., July 1911. G. G. Hedgcock: *9281.* (D: *5699.*)

Asci long-clavate, 90–120 × 10–12 μ (the type "80–100 × 10 μ"), and sporidia naviculate instead of "ovoid"; the other features are in full agreement. Sydow's genus—*Stegopezizella*—and type species are based on J. S. Boyce's *966* on *Abies concolor*, Wasco, Oregon.

PHACIDIUM PLANUM Davis.

Causing needle-blight of *Pinus flexilis* James, Palmer Lake, Colo., July 19, 1917. Hedgcock and Bethel: *26127.* (D: *5619.*)

Sporidia mostly aggregated towards the top of the asci, many of them subacute at both ends, always at the lower end, 24–34 × 3–4½ μ; in type "30–40 × 3 μ." Seems to be in *Stegopezizella* Sydow; when confluent it looks like *Rhabdocline* Sydow.

Phacidium convexum sp. nov.

Apothecia dark-brown, mostly on the inner side of the needles, developing in the mesophyll, penetrating to the bundle-sheath, erumpent through a cleft in the epidermis, less frequently raising and breaking off a flake or lid of the epidermis, issuing by a neck 80–175 μ in thickness and then expanding into a dark, convex, circular or irregularly elongate disk, 300–600 μ wide, total depth 300–350 μ, thecial layer 80–110 μ. Asci cylindric-clavate, 80–102 × 8–9½ μ; paraphyses longer, linear, sparingly branched. Sporidia hyaline, nearly horizontal or irregularly biseriate in the upper part of the asci, then uniseriate, elliptic, continuous, 7–10 × 5–6 μ.

On living needles of *Pinus rigida*, Pisgah Nat. For., N. C., June 7, 1925. G. G. Hedgcock: *24388.* Davidson River, N. C. G. G. H.: *43027.* (D: *5828.*)

Although this species has a strong hypothecium it lacks an adnate lateral exciple and is therefore hardly a true *Phacidium.* It is in this respect similar to the two preceding species described by Dr. J. J. Davis (Trans. Wisc. Acad. Sci. **20**: 424. 1921.) On the same page Dr. Davis described another *Phacidium* in this group —*Ph. expansum* on *Picea mariana*. It is erumpent then expanding, with asci 60–80 × 7–9 μ and sporidia 9–12 × 3–5 μ.

Phacidium taxicolum Dearn. & House, sp. nov.

Apothecia black, hypophyllous, in a line on each side of the midrib, rather sharply pustulate, rising 110–170 μ above the cuticle, dehiscing by 3–4 often unequal laciniae, subepidermal, 250–340 μ at base; lateral wall and floor black, 33–40 μ thick, layer of asci and hyaline hypothecium 44–60 μ deep. Asci subcylindric, narrowing slightly downwards, 33–42 × 4–9 μ; paraphyses linear, hardly as long as the asci, not abundant. Sporidia hyaline, uniseriate, sometimes biseriate in the upper part of the ascus, navicular, mostly minutely nucleate at each end, 7–8 × 2½–2.75 μ.

On blighted leaves of *Taxus canadensis*, Blue Mountain Lake, Hamilton Co., N. Y., Sept. 1920. H. D. House. (D: *4811*.) *Phacidium Taxi* Fries is said to have small, level, grayish-black apothecia; contents undescribed.—Rehm in Rabenhorst's Discomyceten, p. 72. Dr. J. J. Davis (Trans. Wisc. Acad. **21**: 280. 1924) reported collecting this species having asci about 50 × 6 μ, mature spores lacking.

Bifusella Abietis sp. nov.[3]

Apothecia on yellowed leaves, black, nervisequious, interrupted or occupying the whole length of the midnerve, sulcate. Asci cylindric or subclavate, large, saccate, almost aparaphysate, 150–180 × 27–32 μ, 8-spored, before staining appearing to be 16-spored. Sporidia consisting of two fusoid or naviculate portions joined by a slender thread, upper 12–15 × 5–7 μ, lower 10–13 × 3–4½ μ, the joining part 12–25 × 1 μ, all in a jelly sheath reaching a width of 15 μ.

Parasitic and fruiting on year-old and older leaves of *Abies lasiocarpa*, Challis Nat. For., Bonanza, Ida., Aug. 7, 1911. G. G. Hedgcock: *9375*. Also Uncompaghre Mtn., Colo.: *9286*, *9312* and other collections. Sopris Nat. For., Colo. F. V. Keefe: *20136*. Manti Nat. For., C. F. Korstian. J. R. Weir: *6955*.

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[3] This and the following six forms may be interlined in the table of Hypodermata, MYCOLOGIA **16**: 147.

On *Abies arizonica*, Gila Nat. For., N. M. Hedgcock and Long: *9900.* (D: *5700.*)

Found in exactly similar leptostromes on *Abies lasiocarpa*, at Rico, Colo., Payson and Hedgcock: *26035*, a conidial form with hyaline, 3-septate spores, 18–20 × 4–5½ μ, on long conidiophores—**Cystothyrium Abietis** n.s. it may be called—but not under conditions to warrant conclusion that it is related to the *Bifusella*. (D: *5701.*)

Hypoderma Hedgcockii sp. nov.

Apothecia amphigenous but mostly on the inner side of the needles, hypodermal, conspicuous, black, not nervisequious, somewhat convex, wide for their length, .6–1.75 mm. long by .5–.75 mm. wide; slit narrow, lips hardly ridged. Asci bag-like or sub-cylindric, narrowing downward, round at the distal end, contracted at base, sessile, 100–155 × 22–28 μ, 4-spored, seldom 3- or 2-spored, occasionally containing additional, one or more small, jelly-sheathed spores, 6–9 × 3 μ. Stratum of paraphyses mostly about one and a half times the depth of that of the asci; paraphyses jelly-sheathed, abundant, linear, summit sometimes enlarged to 3 μ in width. Sporidia hyaline, granular and guttate, oblong-elliptic, or cylindrical with rounded ends, seldom somewhat slipper-shaped, finally some of them becoming uniseptate, 20–39 × 10–14 μ. When freed from the ascus the jelly-sheath in water swells up to 42 × 30 μ.

Parasitic on needles of *Pinus caribaea*, Silver Springs, Fla., May 15, 1919. G. G. Hedgcock: *32386.* Also on other *Pinus* spp.—*P. virginiana*, Jamestown, Tenn.: *41573*, *P. clausa*, Bolton, Fla.: *25244*, *P. palustris*, Croom, Fla.: *25171*, *P. rigida*, Pisgah Nat. For., N. C.: *11904*, *P. echinata*, Murphy, N. C.: *11988*, and several other collections by Dr. Hedgcock. On *Pinus inops*, Garret Park, Md., May 26, 1891. B. T. Galloway: *1342.* (D: *5827.*)

A form on *P. echinata*, Luray, Va. (G. G. H.: *22342*), has longer and more spindle-shaped sporidia, reaching 42 μ.

This fine species is one of the most distinct of the "tar-fungi." Its *Leptostroma*, described on a succeeding page, is equally conspicuous and more common.

Hypoderma lethale sp. nov.

The affected needles are usually sered for half or more than half their length, the sered or grayish portion usually terminating basally in a brown portion, .5–2 mm. long. Apothecia hypodermal, carbonous outwardly but lacking an internal carbonous floor, amphigenous, subseriate, dull black or somewhat shining when convex, ½–1 mm., sometimes longer, up to 3 to 5 mm., narrow, .2–.35 mm., mostly not wider than the space between two rows of stomata, quite flat, sometimes depressed, convex when well filled with asci, the cleft hardly visible under the microscope. Asci 8-spored, cylindric, or somewhat narrowed below, nearly round at top, 105–120 × 20–30 μ, extreme range of length found in a single apothecium 90–147 μ. Paraphyses filiform, jelly-sheathed, longer than the asci, up to 160 μ, not curved at tip. Sporidia hyaline, continuous, rarely appearing septate or pseudoseptate, obliquely 1-seriate or partly biseriate, granular, mostly obtuse at both ends, 14–29 × 3–5 μ, including jelly-sheath 16–31 × 9–12 μ.

Severely parasitic on needles of *Pinus rigida*, Highfield, Md., July 24, 1914. G. G. Hedgcock: *15626*. At scattered stations from New Hampshire to Virginia. G. G. H.: *2832*, *8063*, *8177*, *15677*, *17790*, *24340*, *36269*, and at Long Island by R. Latham. On *Pinus virginiana*, Maryland to S. Carolina. G. G. H.: *8003*, *8414*, *11777*. On *P. echinata*. G. G. H.: *11948*, *11792*. On *P. serotina*. G. G. H.: *32360*. On *P. Taeda*. G. G. H.: *43052*. (D: *5862*.)

A *Gloeosporium* stage of this species, spores 1½–2 × ¾ μ, on short conidiophores, runs in lines along the stomata producing no macroscopic effect to mark their position. This stage may be the cause of the severe blighting of the needles. "Gray blight" is the name given to it by the Forest Service officers.

HYPODERMELLA LARICIS Tub. var. **octospora** var. nov.

Asci 8-spored, clavate, 42–75 × 17–24 μ, paraphyses as long as the asci.

On *Larix occidentalis* Nutt., St. Maries, Idaho, Sept. 18, 1911. G. G. Hedgcock: *11117*. Also *9473*, *9541* and other collections. (D: *4106*.)

The description and figures of *H. Laricis* Tub. in Tubeuf's Studien die Schuttekrankheit der Kiefer, 1901, pp. 18–21, give the asci 4-spored, 90–110 μ long, cylindric and short-paraphysate.

The material referred to in MYCOLOGIA **16**: 151 was immature compared with some of these collections.

HYPODERMELLA MONTIVAGA (Petr.) Dearn. f. **concolor.**

The form described by Petrak has black apothecia from 1–4 mm. long. In fifteen collections of affected branchlets of *Pinus contorta* made by Hedgcock and others in various parts of Wyoming and Colorado, nine of them were found to have uncolored apothecia. Some of them have the typical black apothecia only; others have both the black and uncolored; while collections numbered *22532*, *22544*, *22593*, *26410*, *26420*, *26426*, *26870* and Boyce *1238* in Montana have uncolored apothecia only. The uncolored sporocarps are usually shorter than the dark ones and are subject to naked-eye detection by sunken depressions, often slight circular pits, in the surface of the needles.

This form may be referred to as f. *concolor*. (D: *4921*.)

Lophodermium australe sp. nov.

Apothecia mostly on the outer side of the needles, less conspicuous, duller, narrower, longer, and flatter than those of *L. pinastri*, black, acute at the ends, so narrow as to be confined between two rows of stomata, the basal pseudoparenchyma centering along a strand of thick-walled hypoderm (sclerenchyma) and depressing the mesophyll to the bundle-sheath, usually .5–2 mm. long by .2–.3 mm. wide but exceptionally 4 or 5 mm. and in one or two examples even 10 mm. long, 125–150 μ deep, carbonized roof 50–80 μ thick, basal layer .5 mm. wide. Asci cylindric, drawn in above to an obtuse summit, of different sizes in the same apothecium and varying from 65–70 × 8–10 μ in some apothecia to 120–150 × 10–12 μ in others; paraphyses linear, abundant, sometimes much exceeding the asci and slightly enlarged at the tip. Sporidia linear, nearly as long as the asci, slightly larger at the top, 1¼–1½ μ thick, with jelly-sheath 6 μ thick.

Mature fruit on languishing or partly green needles of *Pinus palustris*, Silver Springs, Fla., Feb. 27, 1919. G. G. Hedgcock: *32146*. On *P. Taeda*, Brooksville, Fla. G. G. H.: *17436*. Also by the same collector on *P. glabra*, *P. echinata*, *P. resinosa*, mature and immature, in all over forty collections in several of the southern states. (D: *5829*.)

A *Leptostroma* with conidia 5–9 × 1 μ was frequently found in these collections.

Lophodermium Laricis sp. nov.

Apothecia on the outer side of the needles, dark-brown, sometimes surrounded by an innate dark line, short, .6–1½ × .5 mm., elliptic, not strongly testudinate, cleft narrow, lips acutely ridged; the needles are marked by dark, transverse lines. Asci 120–155 × 9–12 μ, nearly cylindric, contracted towards apex, sparsely paraphysate; paraphyses linear, some of them turned at the tip. Sporidia linear, nearly as long as the asci. Conidial leptostromes circular; conidia bacillar, 6–8 × 1–1½ μ.

On needles of *Larix Lyallii* Parl., Bitter Root Mtn., Idaho, Sept. 13, 1911. G. G. Hedgcock: *20240.* (D: *5693.*)

Externally and in dissection this is nearer *L. pinastri* than *L. laricinum*, indeed it may be a host variety of the former.

TYMPANIS BUCHSII (Henn.) Rehm.

On *Pinus monticola*, Stocking Meadows, Ida., Aug. 1923. C. R. Stillinger: *1340.* (D: *4275.*) "Causes cankers on living branches."—C. R. S.

In the probably immature asci eight large, hyaline, elliptic sporidia, 15–17 × 10 μ. These seem to break up into innumerable bacterium-like spores, 2½–3 × .75 μ. In Zur Kenntniss der Discomyceten Deutschlands, 1912, p. 205, Rehm speaks of finding in this species "unentwickelten Schlauchen" with 8 elliptic, hyaline, 1-celled sporidia, 18 × 10 μ.

PYRENOMYCETES

Dimerosporium Abietis sp. nov.

Perithecia on branching brown mycelium, densely clustered on the lower side of the leaves, dark-brown, mostly about 150 μ; hyphal appendages numerous, brown, obtuse, sometimes septate, 30–80 × 4–5 μ. Asci saccate, paraphysate, 40–60 × 21–28 μ, several in the perithecium. Sporidia conglobate in asci, hyaline, 1-septate, 27–30 × 9–10 μ.

Parasitic on the older needles of *Abies amabilis*, Red Mountain, Skamania, Wash., elev. 3300 ft., Aug. 14, 1924. J. S. Boyce: *1261.* Also on *Abies grandis.* J. S. B.: *1263.* J. S. B.: *584* (Mycologia **16**: 154) is probably this species. (D: *5653.*)

Meliola pinicola sp. nov.

Dark-brown mycelial patches on the side of the needles, sometimes surrounding them, 1–4 mm. in diameter; hyphae 8–9 μ thick, branching mostly at a half right angle; hyphopodia 25–30 μ long, head 12 μ thick. Perithecia dark brown, tuberculately-rugose, appendaged with septate, brown hyphae 8 μ thick, subglobose, flattened on the top, 180–275 μ. Asci bisporous, mostly about 50 × 30 μ. Sporidia brown, 3-septate, large, 45–60 × 10–16 μ.

On living needles of *Pinus echinata*, Pisgah Nat. For., Pisgah, N. C., July 6, 1925. G. G. Hedgcock: *24394*. (D: *5878*.)

Dimerium Juniperi sp. nov.

Subicula small, .5–.75 mm., dark, disc-like, seated mostly on the middle of the back of the leaf-scale, consisting of anastomosing, septate hyphae, 6–10 μ. Perithecia congregated on the subicula, concolorous, 80–100 μ. Asci of various shapes, saccate, mostly widest in the lower portion, 31–46 × 9–20 μ, 8-spored, aparaphysate. Sporidia often 1-seriate above and more or less crowded in the lower half, dark-brown, 1-septate, constricted, upper cell usually larger, 11–15 × 4½–6 μ, mostly 12½ × 6 μ.

On green branchlets of *Juniperus occidentalis* Hook., Big Bear Lake, Calif., Aug. 2, 1920. Ellsworth Bethel. (D: *5566*.)

EUTYPELLA SEPULTA (Berk. & Curt.) Dearn. New description.

Stromata scattered, marked externally by a small, black pustule through which short ostiola project; sometimes a black, internal line circumscribes a paler area in which the perithecia are located. Perithecia 1–4, deeply immersed in the unaltered or hardly altered wood, subglobose, separate below, united in the disk by their ostiola, 200–350 μ; ostiola sulcate in well developed examples. Asci minute, 12–16 × 3½–4½ μ, clavate, stipitate; paraphyses not numerous, several times as long as the asci. Sporidia hyaline, allantoid, nucleate at each end, 3–4 × .75 μ.

On dead stems of *Smilax* (*?*)*rotundifolia*, Orient, N. Y., Nov. 1919. R. Latham: *4031*. (D: *4439*.)

There can hardly be any doubt that this is the species on *Smilax* mentioned in the list of imperfectly known *Eutypae* in Ellis & Ev. N. Am. Pyrenom., page 507.

Guignardia Boltoniae Dearn. & Barth. sp. nov.

Perithecia scattered, covered by the cuticle, the short ostiola barely erumpent, 80–110 μ in diameter, depressed-globose, membranous, wall of a single layer of polygonal brown cells, 10–15 μ. Asci 60–75 × 16–19 μ, cylindric-clavate, short-stipitate, aparaphysate; wall 3–4 μ thick at the top. Sporidia hyaline, crowded in the asci, fusoid, subacute at the ends, 15–18 × 4½–5 μ.

On dead stems of *Boltonia diffusa*, Devol, Okla., May 8, 1923. E. Bartholomew: *8051.* (D: *5762.*)

Intimately associated with a microconidial form—**Phoma Boltoniae** sp. nov.—in similar pycnidia, spores 4–7 × 2½–3 μ; and macroconidia—**Macrophoma Boltoniae** sp. nov.—also in similar pycnidia, spores 17–22 × 5–7 μ, fusoid, subacute at the ends.

Guignardia Lonicerae Dearn. & Barth. sp. nov.

Spots reddish-gray with wide red-brown border above, pale-gray beneath, circular, 2–5 mm. in diameter. Perithecia epiphyllous, black, numerous, prominently raising the cuticle, globose at first, becoming plane or even depressed and papillate, deeply seated, 120–160 μ in diameter and nearly as high as wide. Asci aparaphysate, clavate, 48–62 × 12 μ. Sporidia hyaline, continuous, biseriate in the upper part of the ascus, somewhat pip-shaped, widest above the middle, narrowing downward, 12–15 × 6–6½ μ.

On living leaves of *Lonicera hispidula*, Alto Palo, Calif., March 16, 1918. Dr. E. T. Bartholomew. (D: *5842.*)

Mycosphaerella stromatoidea sp. nov.

Spots numerous, scattered, small, 1–1½ mm. circular, border dark, raised, surrounded by a diffuse red band about 1 mm. wide. Perithecia innate, 15–20 so crowded together at the middle of the spot as to seem stromatic, subglobose, about 100 μ wide, opening on the upper side of the leaf. Asci aparaphysate, joined below forming a ball filling the perithecium and adapting their shape to their position, mostly about 45 × 12 μ, sporidia biseriate. Sporidia hyaline, becoming dilutely colored, uniseptate, suboblong, upper cell wider and larger, 12–15 × 5 μ, not constricted.

Parasitic on leaves of *Rumex occidentalis*, Clallam Co., Wash., Aug. 8, 1924. J. S. Boyce: *1288.* (D: *5668.*)

This can hardly be fitted into *S. Rumicis* (Desm.) Cooke.

Mycosphaerella Pachystimae sp. nov.

Spots pale-gray or whitish above the leaf, dark-gray to brown below, with narrow, black, raised border, subcircular, 2–4 mm. Perithecia epiphyllous, seldom amphigenous, evenly scattered, black, innate, rupturing the cuticle stellately, when mature 125–200 μ wide, 85–100 μ deep, nearly hemispheric. Asci 75–78 × 8–9 μ, rounded above, subcylindrical, aparaphysate. Sporidia usually more or less biseriate in the upper half of the ascus, hyaline, uniseptate, somewhat constricted, often with two oil-drops in each cell, 20 × 4–5 μ.

On languishing leaves of *Pachystima Myrsinites*, Coolin, Idaho, alt. 3000 ft., July 27, 1924. J. S. Boyce: *1287*. (D: *5667*.)

Venturia lanea sp. nov.

Perithecia membranous-carbonous, in groups or loose clusters on small, fleecy, whitish patches of mycelium, 1½–3½ mm. in diameter, turbinate, centrally depressed, 180–225 μ across, 100–150 μ high, black, shining; dark-brown, spine-like bristles, 30–45 × 5–6 μ, scattered over the whole surface. Asci 35–50 × 6–8 μ, fusoid; paraphyses lacking or obscure in mature perithecia. Sporidia hyaline, medianly 2-ranked, 1-septate, 4-guttate, navicular, 8–11 × 3 μ.

On bark of *Chamaecyparis nootkatensis*, Upper White River, Wash., Sept. 1924. J. M. Grant: *6018*. (D: *5730*.)

On the bark of the same host—Alaska cypress—same date and same locality, exactly similar bristly perithecia, not on fleecy subicula but in dense clusters around minute, erumpent, dark, wine-colored auriculae suggesting the genus *Gibbera* in the sense of Ellis & Ev. N. Am. Pyrenom., page 248. The sporidia are mostly short-elliptic, enucleate, 1-septate, 6–8 × 3½–4 μ.

Diaporthe Ostryae sp. nov.

Stromata in the outer cortex, no circumscribing line, no visible effect on the cambium side of the cortex. Perithecia single or a few circinating in the bark with connivent, minute, perforate ostiola appearing as black dots through a small, .3 mm., circular rupture of the epidermis, 175–200 μ. Asci cylindric, 58–75 × 7–10 μ; paraphyses obscure. Sporidia mostly obliquely uniseriate, not appendiculate, hyaline, uniseptate, somewhat constricted, upper cell usually larger than the lower one, 15–20 μ long, commonly 18 × 4½–6 μ, upper cell usually 5½–6½ μ wide, lower end often subacute, contents homogeneous.

On dead branches of *Ostrya virginiana*, London, Ont., July 1904. Dearness: *2161.*

This is the same species as Ellis & Ev. N. Am. Fungi *3430*, distributed in 1896 under the label "*Diaporthe ostryigena*," description not published. Barth. Fungi Columb. *2019* in 1905 and Rehm's Ascom. *1989* in 1912 distributed as *Diaporthe ostryigena* Ellis & Dearn., description in Sacc. Syll. Fung. **22**: *377* and on label of Fungi Columb. *2019*, are correctly named. They are very distinct from *D. Ostryae* (N. Am. Fungi *3430*). The latter is near *D. albocarnis* Ellis & Ev. on *Cornus.*

Diaporthe (*chorostate*) **melanocarpa** sp. nov.

Stromata sparsely scattered, for the most part under lenticels, pustular, barely exposed through clefts of the epidermis, 1.75–2.25 mm. in diameter; ostiola small, cylindric, black, shining, dome-like on top but sometimes minutely stellately cleft, crowded, as many as 20 to 25 barely protruding through a cortical disc .8 mm. in diameter. Perithecia numerous, 10–26, 250 μ in diameter, coriaceous, circinating in the inner cortex, slightly imprinting the wood, the group occupying a circle 1–2.25 mm. in diameter, reaching the surface by long, slanting or nearly horizontal ostiola. Asci fusoid, 60 × 7½–9 μ; ? paraphysate. Sporidia straight, hyaline, subseriate, naviculate-fusoid, uniseptate, not constricted, 4- occasionally 6-guttate, 17–22 × 3–4 μ.

On dead branches of *Pyrus melanocarpa*, London, Ont., May 1913. Dearness: *3488.* Newcomb, N. Y., H. D. House.

Comparison with the type of *D. impulsa* (Cooke & Peck) Sacc., to which it seems nearest, shows differences in the size of the sporidia and arrangement of the asci which are not fasciculate as in *D. impulsa.* The ostiola are different in shape and not thrust thru the surface in the manner which probably suggested the specific name of the latter species.

Amphisphaeria pelorospora sp. nov.

Perithecia nearly superficial, carbonous, black, subrugulose, hemispheric to subglobose, 1–1.25 mm. in diameter; ostiola wide, 250 μ, short-papillate. Asci 300–350 × 30–35 μ, 4-spored, short-stipitate, paraphysate. Sporidia brown, 1-septate, constricted, seldom 2 additional septa without constrictions, biconic or oblong-elliptic, ends obtuse-pointed, 75–105 × 30–33 μ.

On outer rough bark of *Nyssa* trunk, Greenport, N. Y., Feb. 1924. R. Latham: *1703.* (D: *5453.*)

This fine thing seems to be the same as my copy of Ellis & Ev. N. Am. Fungi *3012* on *Nyssa* bark with sporidia reaching 102 × 33 μ, labeled *Amphisphaeria papilla* Schw. Syn. Car. No. 159. In the Ellis & Ev. description of Syn. Car. No. 159, in N. Am. Pyrenom. pp. 178–9, sporidia are hyaline and measure 30–50×15–18 μ. The latter can hardly be the species under notice although there is no term in Fries' description of *Sphaeria papilla*, Syst. Myc. 2: 462, that rejects it.

Zignoella ostiolata Dearn. & Barth. sp. nov.

Perithecia scattered or concealed among the fibers, black, carbonous, rough, hemispheric, ¼–½ mm.; ostiola large and variable—papillate, urceolate or even lophiotremous. Asci clavate, paraphysate, 105–120 × 13–16 μ. Sporidia hyaline, 1- to 5-septate, variable in shape,—some acute, others rounded at the ends, constricted, 26–30 × 6–8 μ.

On dead, weathered, woody stems of *Artemisia tridentata*, Thermopolis, Wyo., June 28, 1924. E. Bartholomew: *8734*. (D: *5703*.)

Hypospila californica Dearn. & Barth. sp. nov.

Spots brown, large, 1–3 cm., irregular, unbordered, superficially similar on both sides but under the microscope the upper side of the leaf is depression-dotted over the perithecia while on the lower side their position is marked by the extrusion of the ostiola. Perithecia innate, curling-stone shaped, 240–300 μ wide by 115–140 μ deep, sometimes conic Florence-flask shape and 175 μ deep. Ostiola 90–125 × 45 μ. Asci fusoid, acutely short-stipitate, mostly 4-spored, 36–40 × 6–9 μ. Sporidia hyaline, naviculate, 1-septate, 16–19 × 3–3½ μ.

Parasitic on leaves of *Alnus rhombifolia*, Riverside, Calif., Aug. 12, 1924. E. Bartholomew: *8896*. On *Alnus rubra*, Santa Cruz, Calif. Mary S. Clemens. (D: *5658*.)

Sydowia dothideoides Dearn. & Barth. sp. nov.

Perithecia cespitose or thickly scattered, rugose-membranaceous, developed upon or in a subcuticular, dematiaceous subiculum, erumpent, pseudostromata *Dothidea*-like encinctured by the ruptured cuticle, epapillate, sometimes gaping, .5–.75 mm. Asci cylindric or clavate-fusoid, narrowed apically, polysporous, aparaphysate, 90–160 × 15–20 μ. Sporidia hyaline, mostly irregularly 2-ranked, clavate-subfusoid with rounded ends, 3-

septate, occasionally a lengthwise septum in one of the cells and sometimes an additional cross-septum, strongly constricted, 16–23 μ long, the upper part 4½–9 μ wide, the lower part 3–6 μ wide.

On dead branchlets of *Populus tremuloides*, Jenny Lake, Wyo., July 14, 1924. E. Bartholomew: *8792.* (D: *5710.*)

Its apparently conidial stage is more abundant in the same collection. The pycnidia are smaller than the perithecia but otherwise similar; the conidia are hyaline, subelliptic, 7–10 × 3½–5½ μ. There are also dendryphioid conidia on the subiculum.

A scanty collection of what seems to be this species was also made on *Prunus melanocarpa* in the same locality, July 11, 1924. E. Bartholomew: *8782.*

CUCURBITARIA FRAXINI Ellis & Ev. Proc. Nat. Acad. Phila. 1890, 240:—In an excellent study of the genus *Cucurbitaria* by D. S. Welch, Mycologia **18**: 51–86, *C. Fraxini* Ellis & Ev. is placed in the doubtful list with the remark, p. 66, that the type specimen "furnishes little evidence of what the fungus might have been" and that Griffith's W. A. F. *198* on *Fraxinus* "is clearly not a *Cucurbitaria.*" The type was sent to Mr. J. B. Ellis (I have the cotype) with several other collections on *Fraxinus* and erroneously labeled on that host instead of *Acer saccharinum.* A communicated correction of the error seems to have been overlooked. "*Fraxinus*" in the last line of page 239 in Ellis & Ev. N. Am. Pyrenom. should read "*Acer*" and in the legend of plate 26, ibid., "ash" should be "maple." Fig. 3 of the same plate should show a subiculous stroma under the perithecia—a feature that is quite distinct in the cotype. I am of opinion that the fungus is a form of *Cucurbitaria elongata* (Fries).

A specimen in good fruit on *Prunus melanocarpa*, E. Bartholomew, *6042*, adds a species to the list of hosts of *C. elongata.*

Cucurbitaria naucosa (Fries) Fuckel, Symb. Myc. 173:—Ellis & Ev. (N. Am. Pyrenom. 240) throw doubt on the American record of this species and D. S. Welch, l.c. 77, places it in the list of excluded species. My copy of Ellis & Ev. N. Am. Fungi *3356*, labeled *Dothiorella minor* Ellis & Ev., and related material, No. *491955* of the Field Museum, Chicago, bear, besides the species named on the label, fertile stromata agreeing with the description in N. Am. Pyrenom. 240. The same material might very well pass for *Curreya excavata* (Cooke & Ellis), N. Am. Pyrenom., p. 618, which Thiess. & Syd. would call *Dictyodothis excavata* (Cooke & Ellis), Ann. Myc. **13**: 319.

Cucurbitaria Ceanothi Dearn. & House in the type material shows single as well as cespitose perithecia. The separate perithecia at least have the characters of *Pleospora*—**P. Ceanothi** (Dearn. & House) comb. nov.—as pointed out by D. S. Welch, l.c. 80.

Bagnisiopsis Eucalypti Dearn. & Barth. sp. nov.

Stromata subcircular to elongate, seated in the phloem, edges marked by the broken, slightly upturned epidermis, thinly covered by a somewhat friable remnant of the bark through which the ostiola of the loculi are barely visible, .5 to .75 mm. wide by .75 to 2 mm. long, or by confluence 3 to 5 mm. long. Loculi 60–280 μ in diameter, white-fleshed, in rather crowded groups or ranks. Asci cylindric-clavate, short-stipitate, paraphysate, 75–120 × 15–18 μ. Sporidia 2-ranked above, sometimes obliquely uniseriate, hyaline, continuous, grumous or guttate, elliptic or oftener obovoid, 17–23 × 9–11 μ.

In the bark of dead twigs of *Eucalyptus* sp., San Francisco, Cal., Aug. 2, 1924. E. Bartholomew: *8859*. (D: *5725*.)

Phragmodothidea Dearn. & Barth. gen. nov.

Stromata dothideous, asci paraphysate, ascospores phragmosporous. Differs from *Phragmodothella* Thiess. & Syd. only by being paraphysate and having more than 3 septa in the ascospore.

Phragmodothidea Eucalypti Dearn. & Barth. sp. nov.

Stromata black, rugose, circular or narrow-elongate and usually in linear series, seated in the dermis, rupturing the epidermis stellately or by a rift sometimes over the whole length but often only over the perforate mouths of the loculi, 100–300 μ wide, 55–90 μ deep. Loculi globose or flattish, one to ten in a stroma, often in a single row, white fleshed, 55–150 μ in diam. Asci 60–75 μ long, of various shapes, usually enlarged proximally, often bearing all the sporidia in the lower half and there 20–24 μ across or merely obclavate, 105 × 9–11 μ. Paraphyses linear, septate, seldom branched, longer than the asci. Sporidia hyaline, 6-celled when mature, elliptic-oblong, 17–24 μ long, end cells 3½–4½ μ wide, others 5½–7 μ wide.

In the bark of dead stems of *Eucalyptus* sp., San Francisco, Cal., Aug. 2, 1924. E. Bartholomew: *8859.* (D: *5724.*)

PHYLLACHORA DIPLOCARPA Ellis & Ev. Bull. Torrey Club **24:** 292. 1897.

Homostegia diplocarpa Ellis & Ev. Bull. Torrey Club **24:** 135. 1897.

On *Distichlis spicata*, S. Dakota, Sept. 1923. E. Barth.: *8437.*

Thiessen & Sydow, using Ellis & Ev. N. Am. Fungi *3439,* which in my copy is immature, transferred *P. diplocarpa* Ellis & Ev. to *Endodothella Tracyi* (Ellis & Ev.) Thiess. & Syd. Ann. Myc. **13:** 583. Ellis and Everhart state that they saw only stylospores. Material in both Fungi Columb. *4745,* Calif., and Bartholomew *8437* show not only the 3-septate stylospores ascribed to the species by the authors but also asci, 48–60 × 12 μ and continuous, hyaline sporidia 12 × 6 μ. *Phyllachora Tracyi* Ellis & Ev. Jour. Myc. **4:** 63 has 1-septate sporidia—the mark of *Endodothella.* I failed to find any septate sporidia in the apparently mature material mentioned above.

Oligostroma (*Phyllachora*) **acicola** sp. nov.

Stromata seated in the mesophyll, appearing as short, dark-gray lines under the cuticle, largest reaching 1 × .3 mm. Perithecial cells 1–10 in a stroma, mostly in a single row, sometimes in 2, rarely in 3 rows, depressed-globose, 65–80 μ in diameter. Asci aparaphysate, 30 × 6–9 μ, usually narrowed towards the top. Sporidia hyaline, obliquely uniseriate or biseriate near the base of the asci, uniseptate, 8–10 × 3 μ.

On withered needles of *Pinus palustris* associated with *Cryptosporium acicolum* Thum., Silver Springs, Fla., Feb. 27, 1919. G. G. Hedgcock: *32146.* Also G. G. H.: *17529, 17627, 20827, 25156, 32168.* (D: *5831.*)

Dichaena Pyri Dearn. & Barth. sp. nov.

(?) Stromata blackberry-like warts, circular-pulvinate, 1–3 mm., or transversely elongate up to 6 × 3 mm., 1½–2 mm. high, covered with perithecia, developing in the bark tissue, the core at base wood-colored, fine celled pseudoprosenchyma, opening towards the top before maturity into irregular cavities lined with filiform conidiophores, 10–25 μ long, bearing sperm-like conidia, 2½–3½ × ½ μ, forming, if not washed off, amber beads on the surface. Perithecia nearly black, subglobose or longer, irregular or confluent, areolate, coriaceo-membranous, 15–100 crowded over the stroma, .27–.45 mm. across, .4–.5 mm. high, opening rounded or somewhat elongate. Asci cylindrical, shortly pedicellate, 62–90 × 8–11 μ, 8-spored; paraphyses simple or branched longer than the asci. Sporidia hyaline, elliptic, grumous, 1- to 3- sometimes 5-septate, somewhat constricted in the middle, 10–16 × 6½–9 μ.

On bark round the base of dying apple tree, *Pyrus Malus*, Stockton, Kan., Oct. 1923. E. Bartholomew: *8587*. (D: *5427*.)

DEUTEROMYCETES

Phyllosticta Dracocephali Dearn. & Bisby, sp. nov.

Spots circular at first up to 3 mm. in diameter, then spreading and taking shape from the veinlet enclosures, the point of inception indicated by a white, circular spot 1 mm. in diameter, general color dull brown, somewhat paler beneath, often margined by a narrow, darker band. Pycnidia scattered, numerous, innate, globose, visible as dark specks under the upper cuticle, thin-walled, 120–130 μ deep. Conidia hyaline, densely granular, abundant, oblong with rounded ends, 7–13 × 3½–4½ μ.

On living leaves of *Dracocephalum parviflorum*, Winnipeg, Man., June 19, 1925. G. R. Bisby & I. L. Conners: *2014*. (D: *5867*.)

Phoma Physopellae Dearn. & Barth. sp. nov.

Uredinicolous, externally like *Darluca Filum* (Biv.), one to several botuliform to globose pycnidia, 60–100 × 60–90 μ, on a uredosorus; walls thin, parenchymatic; stomata conspicuous, 10–20 μ high, 15–18 μ wide. Conidia hyaline, continuous, 9–13 × 2.75–3 μ.

Parasitic on *Physopella ficina* on *Ficus aurea*, Cocoanut Grove, Fla., Feb. 28, 1924. L. W. Nuttall: *32*. (D: *5702*.)

Phomopsis Hibisci sp. nov.

Pycnidia erumpent but covered, seated deep in the cortex, scattered, .5–.6 mm.; wall very thin. Conidia hyaline, continuous, of two forms—hamate, 20–30 × 1 μ, and ellipsoid, 5–9 × 2.75 μ; conidiophores 15–30 × 1 μ.

On dead stems of *Hibiscus syriacus*, Orient, N. Y., May 28, 1923. R. Latham; *1717*. (D: *5451*.) This form seems to be somewhat like *Phoma ophites* Sacc.

Sclerotiopsis testudinea sp. nov.

Pycnidia scattered, long axis always parallel to the fibers of the stem, dark-brown, shining, testudinate, .5–1 × .3–.5 mm. Conidia hyaline, slightly curved, acute at each end, 5–8 × 1.75–2.25 μ; on simple and fasciculate-branched conidiophores, 10–30 × 1½–2 μ.

On dead stems of *Paeonia*, Orient, N. Y., Nov. 1919. R. Latham: *4012*. (D: *4442*.)

For an illuminating discussion of *S. concava* by Shear and Dodge with illustrations see Mycologia **13**: 147–9. *S. testudinea* differs externally, but only slightly in the pycnidial contents.

Dothiorella scopulina Dearn. & Barth. sp. nov.

Stromata thickly scattered, encinctured by the ruptured cuticle, disk gray at first, black when mature, .5–1.25 × .5–.75 mm. Loculi one to three or four in a stroma, .25–.5 mm. in diameter, 85–300 μ high, minutely papillate. Conidia hyaline, oblong with round ends, 10–14 × 4–5 μ, or elliptic, 7–10 × 4–6 μ.

On dead branchlets of *Sorbus scopulina*, Jackson Lake, Wyo., July 9, 1924. E. Bartholomew: *8773*. (D: *5709*.)

VALSELLA LASCHII Nits.

On dead branches of *Prunus Besseyi* (cult.), Agr. Coll., Winnipeg, Man., Sept. 1925. G. R. Bisby: *2197*, *2198*. (D: *5911*.)

Both the *Valsella* and a *Cytospora* are on the same branches—the latter probably the undescribed conidial stage of the *Valsella*. Externally the stromata are indistinguishable. The conidia, 4–6 × 1 μ, on fasciculate, branched conidiophores, are developed in labyrinthine cells and escape by a central pore hardly visible in the middle of the white disk at the top of the stroma.

Ceuthospora Populi Dearn. & Overholts, sp. nov.

Stromata scattered, seated in the inner bark, raising the cuticle into subhemispheric pustules and rupturing it, often throwing it off, circular, ½–1 mm., to oblong, 2 × 1–1¼ mm., gray to brown-gray, one or sometimes two or three flat or papillate stomata. Loculi 2–6 in a stroma, more or less labyrinthine. Conidia hyaline, elliptic or oblong with rounded ends, 8–12 × 3–4 μ. Conidiophores 2–2½ μ thick in a layer 15–25 μ deep.

On dead twigs of *Populus grandidentata*, State College, Pa., Nov. 1, 1924. L. O. Overholts: *9460*. (D: *5674*.)

Ceuthospora is often accompanied with related single-celled pycnidia (*Phoma*). There are some such pycnidia on this material which at first contain similar spores, 9 × 3 μ, but they become 1-septate and colored (*Microdiplodia*).

Sphaeropsis amplispora Dearn. & Barth. sp. nov.

Pycnidia evenly scattered, pustulate, not erumpent but perforate and spore-inquinant, .5–.75 mm. in diam.; wall 15–30 μ thick. Conidia brown, nucleate, subglobose, elliptic, or ovate, large, 24–36 × 14–18 μ; on mostly clavate conidiophores, 15–40 × 5–7 μ.

On dead branches of *Acer saccharinum* L., Blue Rapids, Kan., Nov. 1898. E. Bartholomew: *2529.* (D: *5906.*)

Externally much like species of *Steganosporium* on this host.

Sphaeropsis Cercidis Dearn. & Barth. sp. nov.

Pycnidia thickly scattered or seriate, cortical, raising the bark into pustules .5 mm. in diameter. Conidia oblong-elliptic, of uniform content, 18–22 × 9–10 μ; conidiophores 8–17 μ.

On dead twigs of *Cercis canadensis*, Stockton, Kan., Oct. 1923. E. Bartholomew: *8577.* (D: *5429.*)

Sphaeropsis Lycii Dearn. & Barth. sp. nov.

Pycnidia scattered, 6–8 per sq. mm., minute, 150–190 μ, seated in the cortex, slightly erumpent. Conidia dark-brown, oblong-elliptic or pyriform, 14–18 × 9 μ. Conidiophores about 25 μ.

On dead branches of *Lycium vulgare*, St. Genevieve, Mo., Oct. 2, 1923. E. Bartholomew: *8573.* (D: *5428.*)

Haplosporella amygdalina Dearn. & Barth. sp. nov.

Stromata erumpent, embraced by the ruptured cuticle, black, thickly scattered, .25–.45 mm., containing 1–5 pycnidia. Pycnidia obtusely papillate, .125 mm., the stoma only or part of the body up to one third rising above the level of the stroma. Conidia pale brown, content uniform, oblong with rounded ends, enucleate, 15–19 × 7–8 μ, on long narrow conidiophores, 8–15 × 1 μ.

On *Amygdalus Persica*, Stockton, Kan., Apr. 24, 1924. E. Bartholomew: *8673.* (D: *5568.*)

Haplosporella Lathami sp. nov.

Stromata thickly scattered, erumpent, encinctured and partly covered by the raised bark, dull black, nearly flat, sometimes showing the rounded domes of the pycnidia, .3–1.5 mm. Pycnidia 2–8 in a stroma, 150–180 μ in diameter, partitions 30–85 μ thick. Conidia brown, continuous, enucleate, oblong with rounded ends, 15–21 × 6–9 μ; conidiophorous layer about 22 μ deep.

On dead twigs of *Myrica carolinensis*, Mattituck, N. Y., Jan. 1924. Roy Latham: *1585.* (D: *5433.*)

Diplodiopsis Robiniae Dearn. & Barth. sp. nov.

Mature stromata erumpent, black, .5–1.8 × .3–.5 mm., seriate in lines or scattered. Pycnidia in well developed stromata 85 μ in diameter, marked by their hemispheric top which terminates in a shining black ostiolum, 60–85 μ high and 30–35 μ wide, 2–17 in a stroma. Conidia hyaline at first, becoming pale-brown and 1-septate, exceptionally 2-septate, oblong-elliptic, subacute at the proximal end and rounded at the other, 9–20 × 5–8 μ; conidiophores 20–30 μ.

On dead branches of *Robinia pseudacacia*, Stockton, Kan., Nov. 28, 1923. E. Bartholomew: *8610.* (D: *5432.*)

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CULTURAL LIFE HISTORIES OF MELANCONIS AND PSEUDOVALSA[1]

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(WITH PLATES 30–33)

The cultural study of the four species here considered presents further evidence for the existence of correlated characters in the perfect and imperfect stages of these fungi, and supports certain conclusions already drawn by the writer (**18**, **19**) in regard to these generic groups, as pointed out below.

The genus *Melanconis*, as described by the Tulasnes (**17**, 115), includes both of the genera *Melanconis* and *Pseudovalsa*. The genus *Pseudovalsa* was erected by Cesati and De-Notaris (**2**, 206) on the basis of its ascospores which are three- to many-celled instead of two-celled as in *Melanconis*. There are certain other characters correlated with this difference in the septation of the ascospores.

Although the genus *Melanconis*, as it now stands, contains certain species which obviously have relationships elsewhere, nevertheless, as a generic group it can be quite distinctly recognized. The species of this group have two-celled, hyaline or brown ascospores which are uniseriate or biseriate within a clavate to cylindrical ascus, a well developed ectostroma, practically no entostroma and no blackened zones within the substratum, and a *Melanconium* stage in their life history, often accompanied by a second type of hyaline cylindrical conidium.

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Saccardo (16, 740) erected the genus *Melanconiella* for the brown spored species of *Melanconis*. Winter does not recognize this separation, and Ellis merely uses it as a subdivision of the genus. There are certain other characters associated with this difference in spore color, but there are intermediate forms linking the two groups into a continuous series and making any generic separation unfeasible. The hyaline spored species tend to have their spores biseriate in clavate asci; have light colored ectostromata; usually have colored conidia of a lighter tint; and usually have a second type of hyaline cylindrical conidium mixed in with the colored conidia. The brown spored species tend to have their spores arranged uniseriately in a cylindrical ascus; have yellowish- to olive-green ectostromata; have dark colored conidia; and normally do not show the second type of conidium.

The genus *Pseudovalsa*, as it now exists, contains species showing a wider variation and less homogeneity than the genus *Melanconis*. Here too, however, there is a group, including the type species *Pseudovalsa lanciformis* (Fries) De-Not., which shows closely correlated characters. These species have a very strongly developed, dark colored ectostroma, beneath which there is usually a rich development of dark colored entostromatic mycelium within an area of bark tissue at first delimited by a blackened marginal zone. These two tissues are almost indistinguishable at maturity. The ascospores of this group are many celled, larger in general than in *Melanconis*, and are 2- to 3-seriate within broad clavate asci. The imperfect stage is of the form genus *Coryneum*, with sometimes a second hyaline cylindrical type of conidium.

Other species of *Pseudovalsa* show close relationships with certain species of the Massariaceae, and probably should be placed in that family. Petrak (12, 114) and others have already pointed out that *Pseudovalsa* (Aglaospora) *profusa* (Fries) Wint. belongs with *Massaria inquinans* and related species. The species of *Pseudovalsa* placed by Petrak (13, 324) in his genus *Prosthecium* Fres. are very similar in structure to such forms as *Massaria platanoides* Ces., *M. argus* (Berk. & Br.) Fres., etc. The writer hopes to undertake a cultural study of these forms which should reveal many interesting relationships.

MELANCONIS STILBOSTOMA

Melanconis stilbostoma (Fries) Tul. was collected on *Betula alba* L. near Hubbardston, Mass. It is a representative of the group with hyaline ascospores.

The fungus appears on the surface of the twigs as numerous, circular, pustulate swellings, 1–2 mm. in diameter, through the center of which there project the circular or laterally elongated, white to yellowish, ectostromatic discs, which contain the scattered conical to cylindrical, punctate ostioles. The perithecia are spherical or irregular in shape, 400–640 × 320–400 μ, and arranged circinately beneath the ectostroma, in the unaltered bark cortex (PL. 30, F. 1). The asci (PL. 31, F. 4) are clavate and measure 75–120 × 9–14 μ. The ascospores (PL. 31, F. 5) are biseriate in the ascus, often becoming obliquely uniseriate, elliptic-fusoid, 2-celled, hyaline, constricted at the septum, and measure (13) 15–22 × 5–8 μ, depending upon their degree of maturity.

This species is based on the *Sphaeria stilbostoma* of Fries (**7**, 102; **8**, 403). Fries' type material (Scler. Suec. *145*) in the Farlow Herbarium shows ascospores which, although apparently immature, have indications of three septa and often of appendages at the ends; they measure 20–27 × 5.5–7.5 μ. Other exsiccati of *S. stilbostoma* Fries (Desm. Fl. Cr. Fr. *1257*, Fuckel, Fung. Rhen. *590*) show typical specimens of *Melanconis stilbostoma.* Many of the European exsiccati show spores with an outer gelatinous sheath which is enlarged at the ends to produce appendage-like processes. This is due to the adherence of a layer of the periplasm of the ascus to the spore, especially when not mature, and is not a constant character.

Suspensions of ascospores of this species were sprayed onto agar on October 21, 1925. Twenty-four hours later these spores were germinating by means of a single germ tube 2.5–3.5 μ in diameter. The germinating spores measured 20–23 × 7–9 μ.

Single spore cultures on six per cent oat agar produced a very scant superficial mycelial growth, and a number of spherical to cylindrical, white to yellowish, superficial stromata. These stromata on agar all remained sterile.

On November 5, steam sterilized twigs of *Betula alba* L. were inoculated from a single spore culture. Numerous, erumpent, superficial, hemispherical, whitish stromata were formed upon these twigs, but most of these remained sterile. On the upper drier portion of one twig a number of conidial stromata (PL. 31, F. 1) were formed. The conidial stromata were entirely ectostromatic and originated as white cushion-like masses of mycelium upon the surface of the bark. The central portion of this mycelial tissue tends to grow upwards more rapidly than the peripheral regions. The pressure of this continued growth soon ruptures the periderm and exposes the stroma as the erumpent disc of this species. If a conidial hymenium arises before the overarching periderm is ruptured, it is formed over the entire surface of the ectostroma, and there results a dome-shaped basal stroma clothed with a conidial hymenium, the whole opening to the exterior through a pore in the enclosing periderm. If, on the other hand, the central portion of the stroma bursts through the periderm before conidial formation is initiated upon its surface, this exposed portion remains sterile and conidial hymenia are formed only on the flanks of the stroma still protected by the periderm. The conidial cavities thus formed are lined by a definite hymenial layer of cylindrical hyaline conidiophores measuring 27–37 × 1.5–2 μ. These conidiophores abstrict conidia of two types; one of these is elliptical to fusoid, often narrowed towards one end, one-celled, light brown in color, and measures 13–18 × 4–7 μ (PL. 31, F. 3), while the second type is cylindrical, often slightly curved, one-celled, hyaline, and measures 6.5–12 × 2–2.5 μ (PL. 31, F. 2).

The Tulasnes (17, 119) report conidia of three types for this species. Their connection of spermatia, which are slightly curved, 13–20 μ long, and born in labyrinthiform loculed spermagonia, is undoubtedly incorrect. This type of fruit body, which they give as *Naemospora crocea* (Pers.) Fries, *Libertella betulina* Maz., etc., is of the type produced by species of the Allantosphaeriaceae and is very doubtful for a species of *Melanconis*. The second conidial fruit body mentioned (*Melanconium bicolor* Nees., *M. betulinum* Schm. & Kunze, *M. elevatum* Corda, etc.) consists of a stroma with open cavities within which are formed brown ovate conidia measuring 13–16 × 7–10 μ, and hyaline cylindrical "conidiola" half as long. This corresponds very well to the imperfect stage obtained in pure cultures of this *Melanconis*.

Melanconis stilbostoma, *M. Alni* Tul., and *M. marginalis* (Peck) Weh. all have overlapping ascospore measurements and identical stromatic characters. *M. stilbostoma* differs from the other two species in the lack of appendages upon its spores. In a previous discussion of *M. Alni* and *M. marginalis*, the writer (**19**) kept these two species separate chiefly upon the fact that the Tulasnes (**17**, 122) gave *Melanconium sphaeroideum* Link, with brown ovate conidia measuring 10–13 × 6.5–7.5 μ, as the imperfect stage of *M. Alni*, while pure cultures of *M. marginalis* yielded dilute blackish conidia measuring 10–14 × 4–5 μ. In examining a number of exsiccati of *M. stilbostoma*, there was found constantly associated with it a *Melanconium* with brown conidia measuring 10–15 × 5.5–8 μ, and indistinguishable from those of *M. sphaeroideum*. This again points to the uselessness of depending too much upon observational connections, especially when two or three closely related species occur frequently on the same or similar hosts, and makes a cultural study of the European species all the more desirable.

No evidences of perithecial production were found in any of the cultures of this species.

MELANCONIS DECORAENSIS

Material of *Melanconis decoraensis* Ellis was collected on twigs of *Betula alba* L. near Waverly, Mass. This material agreed in all respects with Ellis type material (N. Am. Fungi *1562*). Peck (**11**, 70) described this as *Melanconiella decorahensis* Ellis and gave the disc as "yellow-green" rather than "sordid-gray," as given by Ellis. Ellis (**6**, 528) made this a variety *subviridis* Peck. This is merely the fresh growing condition of the fungus, the disc being greenish pulverulent when fresh and becoming dirty gray with age.

The fungus appears superficially as small slightly pustulate swellings of the periderm with a central, laterally elongated, gray to olive-green disc which is barely erumpent through a slight rupture in the periderm. This disc is usually entirely ectostromatic but occasionally penetrates slightly into the bark. The perithecia are spherical to ellipsoidal, 460–1100 × 350–800 μ, and are arranged circinately in the unaltered bark tissue beneath the erumpent disc (PL. 30, F. 2). The asci (PL. 31, F. 8) are long cylindrical with a short stipe-like base and a refractive ring in the tip, and measure 95–120 × 9–11 μ. The spores (PL. 31, F. 9) are obliquely uniseriate to uniseriate in the ascus, fusoid-elliptical, brown, 2-celled, constricted at the septum, acute at the ends, and measure 13–17 × 6.5–8 μ.

Ellis (6) remarks that this species differs from *Melanconis spodiaea* Tul. only in the absence of appendages on the spores. Many exsiccati of *M. spodiaea* show no trace of appendages, while others (Rehm, Ascom. *1145*) do show small cap-like hyaline appendages. These appendages are apparently evanescent, as is the case in many other species of this genus. Figures nine and ten (PLATE 31) are camera lucida drawings of these two species. A comparison of these figures will show that the spores of *M. spodiaea* tend to be somewhat longer and narrower (14–18 × 5.5–7.5 μ), less strongly constricted and more blunt at the ends than those of *M. decoraensis*. Here again we find two closely related species, one (*M. spodiaea*) reported only from Europe, while the second (*M. decoraensis*) has so far been found only in America.

Suspensions of the ascospores from *Betula alba* were sprayed onto agar on September 24, 1925. The following day a few spores were found germinating and additional spores germinated on succeeding days. The germinating spores did not swell, measured 16–18 × 7–9 μ, and produced 1–3 successive germ tubes 3–4 μ in diameter.

Single spore cultures on oat agar produced a superficial mat of white mycelium. Within this mass of hyphae spherical to pulvinate blackened masses appeared. These were more compacted areas of stromatic tissue within which conidia were cut off indiscriminately from the hyphae. The hyphae were finally almost entirely used up in the formation of conidia, and a black mass of spores remained. These conidia (PL. 31, F. 7) were elliptical to ovoid, often with a terminal papilla or scar where attached to the hypha, dark brown in color, and measured 13–20 × 5–8 μ. In old cultures these conidia became much contorted and presented irregularly bulging outlines.

On November 5, steam sterilized twigs of *Betula alba* L. were inoculated from single spore cultures. On the moist portions of these twigs there were produced erumpent-superficial, grayish to olive-green stromata, which usually remained sterile. On the drier portions of the twigs normal conidial stromata were produced. These fruit bodies arose as mycelial mats upon the surface of the bark. As this tissue increased in amount the older portions took on the typical yellowish-green coloration. Conidial production took place by the swelling of the tips of the marginal, hyaline, actively growing hyphae of this ectostroma. After the laying down of a wall behind this swollen tip, the wall of the spore was thickened and then given a brown coloration. The cross wall cutting the spore off from the hypha is often laid down some distance behind the swollen portion, producing a basal papilla. If conidial production takes place early in the growth of the ectostroma, a hymenial layer of cylindrical conidiophores, measuring 18–27 × 3, 5 μ, are produced over the entire, somewhat dome-shaped surface. The central portion of the ectostroma usually grows more rapidly, however, and ruptures the periderm before conidial production takes place. Upon exposure to the air these hyphae take on the yellowish coloration mentioned, and the production of conidia is limited to the lateral flanks of the stroma. In culture there was usually formed, also, a mass of stromatic tissue between the bark and wood, a condition rather unusual in this genus. The lower actively growing margin of this tissue also produced a hymenial layer resulting in a sort of inverted conidial cavity within the tissue (PL. 31, F. 6).

Ellis (5, 75) gives a *Melanconium* with "pip-shaped," olive-black conidia, the same size as the ascospores, as accompanying this species. Such an associated *Melanconium* with blue-black conidial masses also occurred on the writer's material. These conidia were somewhat larger than those obtained in culture, measuring 19–22 × 9–10 μ.

PSEUDOVALSA LONGIPES

A limited number of pustules of *Pseudovalsa longipes* (Tul.) Sacc. were found on twigs of *Quercus coccinea* Muench. sent to the writer by H. M. Kerber from Scranton, Pa. This material agrees in every respect with Ellis, N. Am. Fungi *2758* (in Farlow Herb.) of *Pseudovalsa sigmoidea* (Cooke & Ellis) Sacc. Ellis' type material of *P. sigmoidea* (N. Am. Fungi *1566*) shows only immature hyaline spores of this species. All of the European material of *Pseudovalsa longipes* examined by the writer has shown only hyaline spores. This species is described as having brown ascospores, however, and since the immature material of both *P. sigmoidea* and *P. longipes* are identical, these two species are undoubtedly synonymous. Currey's figures (4; *pl. 47, f. 90 and pl. 48, f. 167*) of *Sphaeria arcuata* and *Sphaeria quercina,* which the Tulasnes (17, 139) give as synonyms of their *Melanconis longipes,* are also typical of the material here considered.

The fungus appears on the surface of the twigs at first as small conical pustules, caused by the formation of the small ectostromatic disc beneath the periderm. The periderm is ruptured irregularly and the blackened disc with the small papillate ostioles is exposed but scarcely erumpent. The small spherical perithecia, 320–450 μ in diameter, are formed within an area of bark cortex outlined by a blackened zone of tissue. There is a rapid development of dark colored entostromatic mycelium within this area, so that at maturity the perithecia seem to be imbedded in an immersed stroma (PL. 31, F. 11). The asci (PL. 32, F. 4) are stout- to elongate-clavate, and measure 100–150 × 13–25 μ. The spores (PL. 32, F. 3) are 2- to 3-seriate in the ascus, long cylindrical, straight or somewhat curved, acute at the ends at first, finally blunt, hyaline at first becoming brown at maturity, 4- to 8-septate, constricted at the septa, and measure 45–75 × 5.5–11 μ. The spores of this species remain hyaline for some time, becoming brown only when fully mature.

Sprays of an ascospore suspension of this species were made on November 22, 1922. Forty-eight hours later some of the spores were found germinating by means of germ tubes from one or both of the end cells, or occasionally from one of the central cells.

Single spore cultures on oatmeal agar produced at first a yellowish-brown discoloration of the agar, and a very slight growth of mycelium which later took on a gray-green tint and finally formed a blackened zone on the surface of the agar. In from two to three weeks, large, hemispherical, grayish- to yellowish-green stromata, 3–5 mm. in diameter, were produced. These stromata exuded greenish-black droplets, and later produced conidia over their entire surface. The first growth of these stromata consisted of fine yellowish interwoven hyphae, 1–2 μ in diameter. The tips of these hyphae were hyaline and more or less parallel, forming a hymenium from which were produced numerous filiform, hamate or curved, hyaline, one-celled conidia measuring 8–15 × 1–1.5 μ (PL. 32, F. 8). In the later growth of the stroma the hyphae became much enlarged and their walls were thickened and browned. These hyphae were 4–12 μ in diameter, and from their apices were formed a second type of conidium (PL. 32, F. 6) of the form genus *Coryneum.* These conidia varied in shape from cylindric-clavate to irregular-fusoid; they were straight or variously curved or bent, yellow-brown in color, 3- to 8-septate, and measured 47–104 × 10–14 μ. They were normally found only on the surface of the stroma, but occasionally were found imbedded somewhat beneath the surface.

On December 6, 1922, steam sterilized twigs of *Tilia americana* L. and *Quercus rubra* L. were inoculated from a single spore culture. All of these twigs developed erumpent-superficial stromatic cushions like those formed on agar. The conidial stage on twigs was entirely ectostromatic and originated on the surface of the bark as a mycelial cushion which finally ruptured the periderm. The *Tilia* twig cultures, when examined on Feb. 7, 1923, showed the *Coryneum* stage of the fungus. These stromata (PL. 32, F. 1) were composed of a dense mass of upright parallel, brown, septate hyphae, which abstricted the conidia (PL. 32, F. 5) from their apex. These conidia measured 28–90 × 8–13 μ, and formed black irregular masses upon the surface. Later cultures on twigs of *Tilia* coated with paraffin gave the second type of stroma bearing the hyaline filiform conidia.

The cultures on oak twigs gave chiefly this second type of stroma (PL. 32, F. 2) which was more compact and made up of yellowish hyphae 1–2 μ in diameter. The apical portions of these hyphae were arranged parallel to one another, were hyaline, and cut off hyaline, filiform conidia measuring 10–20 × 1 μ from their tips (PL. 32, F. 7). No indications of the formation of perithecial stromata were found in any of these cultures.

Coryneum Kunzei Corda is given by the Tulasnes (17, 139) as the imperfect stage of *Pseudovalsa longipes*. They give the conidia as 4- to 6-celled and 50–60 × 13–16 μ. Ellis, N. Am. Fungi *632* of *C. Kunzei* shows spores 40–90 × 9–15 μ. A *Coryneum* stage found associated with *P. longipes* on Krieger, Fung. Sax. *79* showed 5- to 8-celled conidia measuring 45–55 × 13 μ. The conidia of this *Coryneum* are undoubtedly quite variable in size and shape as was seen to be the case in culture. The Tulasnes suggest the possible existence of a second type of conidium when they state that if "spermatia" or "microconidia" do exist they have not been noticed by them. The cultures of this species show that such a second type of conidium does exist here as in other species of *Melanconis* and *Pseudovalsa*.

PSEUDOVALSA LANCIFORMIS

Material of *Pseudovalsa lanciformis* (Fries) Ces. & De-Not., agreeing with descriptions and all of the exsiccati examined, was collected on *Betula alba* L. near Quincy, Ill.

The stromata of this species vary greatly in size. The pustules formed on the surface are small, circular, conical and 1–1.5 mm. in diameter, or larger, laterally elongated and 2–5 × 1–2 mm. The stroma is more or less widely erumpent as a circular or fusoid blackened disc containing, when well developed, the short stout cylindric ostioles. The perithecia are spherical to ellipsoidal, 320–500 × 250–420 μ, and are irregularly arranged within a strongly developed stroma of grayish to black fungous tissue which rests upon the first layer of stone cells beneath the bark surface (PL. 30, F. 3). The asci (PL. 33, F. 3) are clavate to cylindric-clavate, and measure 109–145 × 18–22 μ. The paraphyses are filiform, band-like. The spores (PL. 33, F. 2) are biseriate in the ascus, elliptic-fusoid, light brown, 5–7- (usually 6-) celled, and measure 30–45 × 10–15 μ. The ends of the spores are blunt and often capped by a small hyaline area.

Although the writer has not seen Peck's original material, his *Melanconis elliptica* is undoubtedly a synonym of this species. In his original description (**9**, 102) he states that *M. elliptica* differs from *M. lanciformis* in its smaller ascospores (27–34 × 12.5 μ). In a later note (**10**, 87), he, for some reason, transfers this species to the genus *Diatrype*, and states that the spores often reach a length of 45 μ.

Pseudovalsa umbonata (Tul.) Sacc. is this same species on *Quercus*. The Tulasnes (**17**, 138) give no spore measurements for this species, but their description and plate show its similarity to *P. lanciformis*. Winter's spore measurements for *P. umbonata* are those of *P. lanciformis*. The only two exsiccati of *P. umbonata* showing mature spores (Tranz. & Ser. Myc. Ross. *28* & Rehm, Ascom. *227*), seen by the writer, were identical with the specimens of *P. lanciformis* examined. The stromata on oak tend to be circular and not as large as those sometimes found on birch.

A suspension of ascospores from birch twigs was sprayed onto agar on September 27, 1925. Twenty-four hours later a number of spores were found germinating, usually by means of a germ tube from each of the terminal cells. These germ tubes, which also occasionally arose from one of the central cells, were 3–4 μ in diameter. This germination from the terminal cells is not a chance happening, but due to the structure of the ascospore. A small circular area of the apex of the ascospore wall is modified so as to form an easily dissolved germ pore (PL. 33, F. 6). No differential staining reaction was found for this area, but it usually appears as an indefinite hyaline cap. If the spores be placed in a solution of eosin, the protoplasts absorb the stain slowly due to the difficulty of penetration of the brown walls. The end cells become stained long before the central ones due to the easy penetration of the end wall. Each of the protoplasts within the several cells of the ascospore possesses an elastic, outer, plasma membrane, and may expand or contract under varying osmotic conditions. The protoplasts of the terminal cells are lodged in contact with the thin apical germ pore wall. Upon germination these terminal protoplasts take up water and push out a germ tube through the softened end wall (PL. 33,

F. 5). The hyaline plasma membrane can be distinguished as being continuous about the periphery of this germ tube. When the spores are treated with rather concentrated sulphuric acid, the terminal germ pore gelatinizes and dissolves, and the terminal protoplasts are forced out through the opening thus formed (PL. 33, F. 7). If this action be more violent, the protoplasts of successive cells, along with a gelatinous material which surrounds them within the spore, are pushed out through this opening (PL. 33, F. 8).

Single spore cultures on oat agar produced numerous, pulvinate, grayish-green to black, superficial stromata. On January 11, 1926, conidia were found in these cultures. The interior of the stromata were composed of a fused mass of hyaline hyphae, while the outer layers in the majority of cases, which remained sterile, were composed of dark-walled intertwined hyphae. In the case of the fertile stromata the actively growing tips of the exterior hyphae produced brown colored conidia successively from their apices forming a compact black mass of conidia on the surface of the stroma. These conidia (PL. 33, F. 4) were fusoid-elliptical to clavate, tapering towards the ends but truncate at the apex, brown, 4- to 6-celled, and measured 31–45 × 13–15 μ. The conidia formed in culture were more irregular in outline than those found under natural conditions.

On November 5, 1925, steam sterilized twigs of *Betula alba* L. were inoculated from a single spore culture. Numerous erumpent-superficial, irregularly pulvinate to elongate, grayish to black stromata were formed in these cultures. They were entirely ectostromatic, arising on the bark surface and breaking through the periderm. These stromata had a structure similar to that of the stromata formed on agar, and some of them produced the normal *Coryneum* type of fruit body (PL. 33, F. 1). In many cases, however, an unusual condition arose. In these stromata (PL. 33, F. 10) the conidia were formed in what must be considered a pycnidial locule. Ruhland (15, 57) in his discussion of the development of this species described what he says is apparently a pycnidial formation. He interpreted this condition as resulting from the formation of conidia upon the apical hyphae of the young stroma before it had ruptured the periderm.

These conidiophores, he says, being too delicate to rupture the thick periderm were crowded together by their own growth while the outer heavy walled area of the stroma grew upward, ruptured the periderm, and more or less enveloped this group of conidiophores, forming a cavity with a small apical opening. To the writer, this interpretation seems improbable, and certainly is not the case with the pycnidial formations in culture. In the first place the outer heavy-walled cell layers of the stroma are composed of empty cells and could not grow up around the conidiophores, as stated by Ruhland; secondly, the pycnidia formed in culture were in the superficial portion of the stroma, and not beneath the periderm; and thirdly, the conidia were formed within the central, hyaline, actively growing tissue of the stroma, and not upon its surface. What actually occurs is as follows. It has already been mentioned that in this species the inner portions of the conidial stromata are composed of actively growing hyaline hyphae. Under normal conditions these hyphae produce the conidia from their apices on the surface of the stroma. It has also been noted that in culture sterile stromata are formed, in which case the terminal portions of the hyphae become thick-walled and browned without the formation of conidia. It is in such stromata, in which the central mass of hyaline hyphae has remained in an actively growing condition, that conidial locules are formed. These central cells in such stromata are filled with protoplasm and take a deep stain with eosin. Certain cells, scattered indiscriminately throughout this tissue, enlarge, become septate, and give rise to typical conidia (PL. 33, F. 9). These scattered conidia remain imbedded within the central hyaline matrix, which is in turn surrounded by the outer wall-like layers of dark colored thick-walled cells. This formation of conidia scattered throughout a primordial tissue is similar to that described by Archer (1) for *Asterosporium Hoffmanni* Kunze, except that in *Asterosporium* the entire central tissue is used up in the formation of conidia leaving a true pycnidial locule. No perithecial stage is known for this *Asterosporium*, but the writer considers it probable that it is the imperfect stage of one of the Massariaceae, a number of which have a *Hendersonia* stage in their life history. It has already been stated that some species of

Pseudovalsa show relationships with the Massariaceae. In this connection it is interesting to note this apparent transitional formation between a *Coryneum* and a *Hendersonia*-like fruit body. This pycnidial formation of *P. lanciformis*, to be sure, is strongly stromatic and superficial, and does not resemble the sub-epidermal pycnidia of certain species of *Massaria*, but it does show the possible common origin of pycnidial and *Coryneum*-like fruit bodies.

The Tulasnes (17, 135) give *Coryneum disciforme* Corda as the imperfect stage of their *Melanconis lanciformis*. This imperfect stage (Fuckel. Fung. Rhen. *2334* and Krieg. Fung. Sax. *436*) shows a stromatic structure and conidia (37–46 × 13–15 μ) identical with the *Coryneum* found in culture. The Tulasnes also mention and figure hyaline, curved, cylindrical "spermatia." No such second type of conidia has so far been found in any of the writer's cultures. The same authors (17, 138) give *Coryneum umbonatum* Nees (*Steganosporium elevatum* Riess) as the imperfect stage of *P. umbonata*. The conidia of *C. umbonatum* are identical with those of *C. disciforme* except that the width of the spores, according to various descriptions, is somewhat greater (16–22 μ) for *C. umbonatum*. Saccardo's Myc. Ital. *1568*, of *C. umbonatum* on *Quercus*, does show such somewhat larger spores (46–55 × 18–22 μ). Whether this constitutes a variety on oak, or is merely a variation due to the different substratum, is another question which can be settled only by a comparative cultural study of material from the two hosts. Riess (14), in his discussion of *Steganosporium elevatum*, speaks of the fruit body as a "pseudoperithecium," and states that the spores are at first enclosed within a wall-like membrane, which suggests the condition already described from cultures of *P. lanciformis*.

Currey (3) connects *Hendersonia polycystis* Berk. & Br. (*Myxocyclus confluens* Riess) with *Sphaeria lanciformis*. This is undoubtedly incorrect, as this *Hendersonia* has muriform conidia enclosed within a gelatinous sheath, and is probably the imperfect stage of one of the Massariaceae.

Ruhland (15) considers *Pseudovalsa lanciformis* to belong to his "haplostromatic" type, that is, to be lacking in the possession of any entostroma. No perithecial stromata were formed in culture, but in nature these stromata are chiefly, and sometimes entirely, ectostromatic, being formed upon the bark surface. The blackened surface zone of this ectostroma often penetrates into the bark as far as the first layer of stone cells, however, and when this is the case the enclosed bark area is thickly intergrown with blackened entostromatic hyphae which form a blackened sclerotial mass scarcely distinguishable from the ectostroma. The perithecia are usually formed within the ectostroma.

SUMMARY

The imperfect stages of two species of *Melanconis* and two species of *Pseudovalsa* were obtained in single ascospore cultures.

Melanconis stilbostoma (Fries) Tul., with hyaline ascospores, produced a *Melanconium* stage agreeing with *M. bicolor* Nees, and containing a second type of hyaline cylindrical conidium intermixed with the brown elliptical conidia.

Melanconis decoraensis Ellis, with brown ascospores, produced a *Melanconium* stage, but no second type of conidium.

Pseudovalsa longipes (Tul.) Sacc. produced a *Coryneum* stage agreeing with *C. Kunzei* Corda, and also a second type of hyaline cylindrical conidium. *P. sigmoidea* (Cooke & Ellis) Sacc. is given as a synonym of *P. longipes*.

Pseudovalsa lanciformis (Fries) Ces. & De-Not. produced a *Coryneum* stage agreeing with *C. disciforme* Corda, but no second type of conidium. Identical conidia were also produced in pycnidial locules enclosed within a stroma. The presence of apical germ pores in the ascospores was noted and described. *Pseudovalsa umbonata* (Tul.) Sacc. is given as a synonym of *P. lanciformis*, with evidences for its being a variety on *Quercus* due to a difference in the size of its conidia (*Coryneum umbonatum* Nees).

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CAMBRIDGE, MASS.

EXPLANATION OF PLATES

PLATE 30

Fig. 1. Vertical section of perithecial stroma of *Melanconis stilbostoma* (Fries) Tul., on *Betula alba* L.

Fig. 2. Vertical section of perithecial stroma of *Melanconis decoraensis* Ellis, on *Betula alba* L.

Fig. 3. Vertical section of perithecial stroma of *Pseudovalsa lanciformis* (Fries) Ces. & De-Not., on *Betula alba* L.

PLATE 31

Melanconis stilbostoma (Fries) Tul.

Fig. 1. Vertical section of conidial fruit body as formed in culture on *Betula alba* L.

Fig. 2. Hyaline cylindrical type of conidium produced in culture.

Fig. 3. Brown *Melanconium* type of conidium produced in culture.

Fig. 4. Ascus with ascospores.

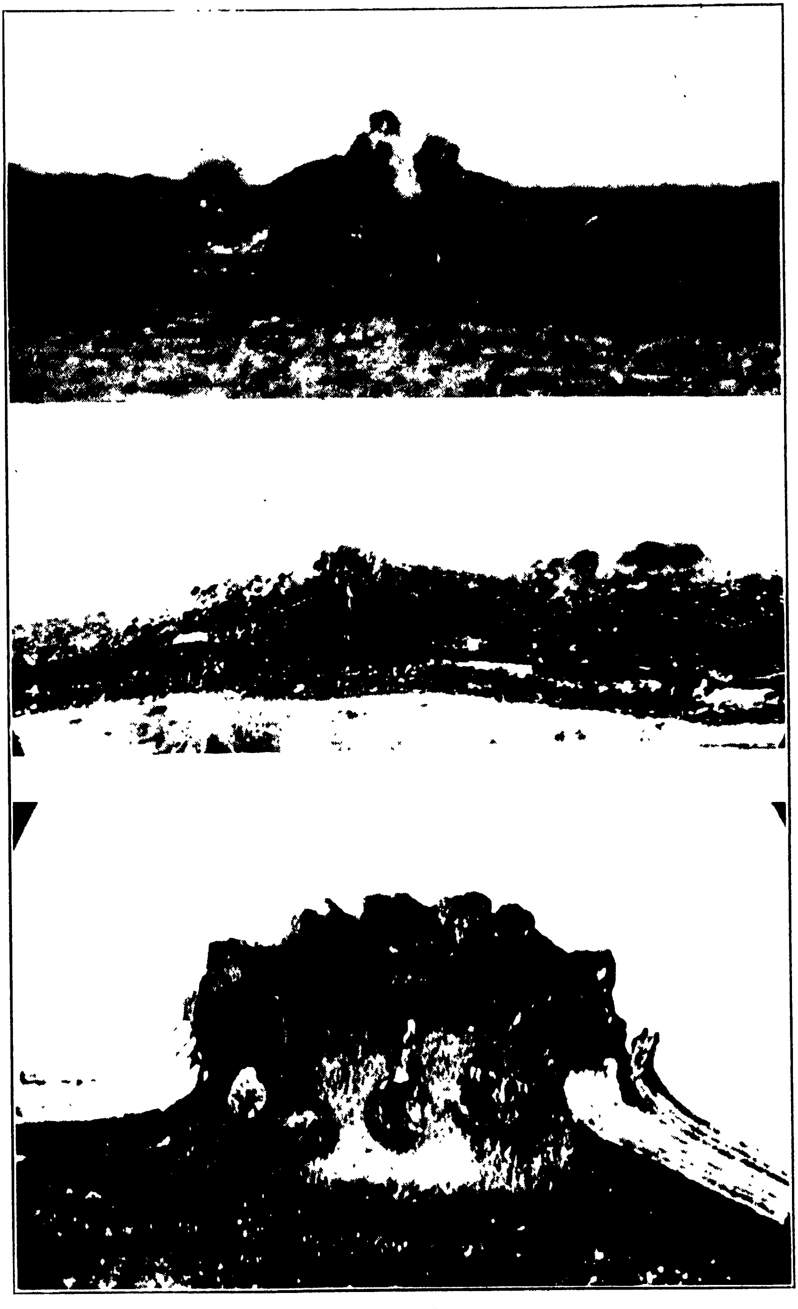
Fig. 5. Ascospores.

Melanconis decoraensis Ellis

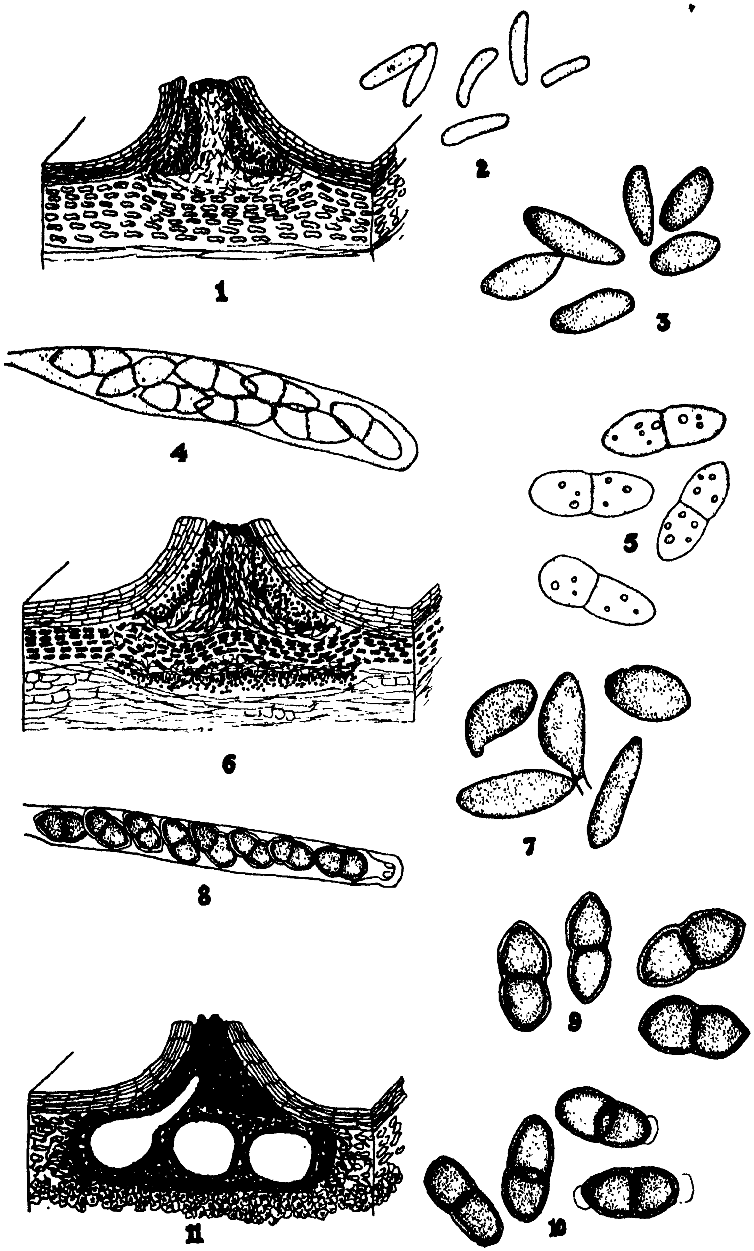
Fig. 6. Vertical section of conidial fruit body as produced on twigs of *Betula*.

Fig. 7. Conidia of *Melanconium* stage produced in culture.

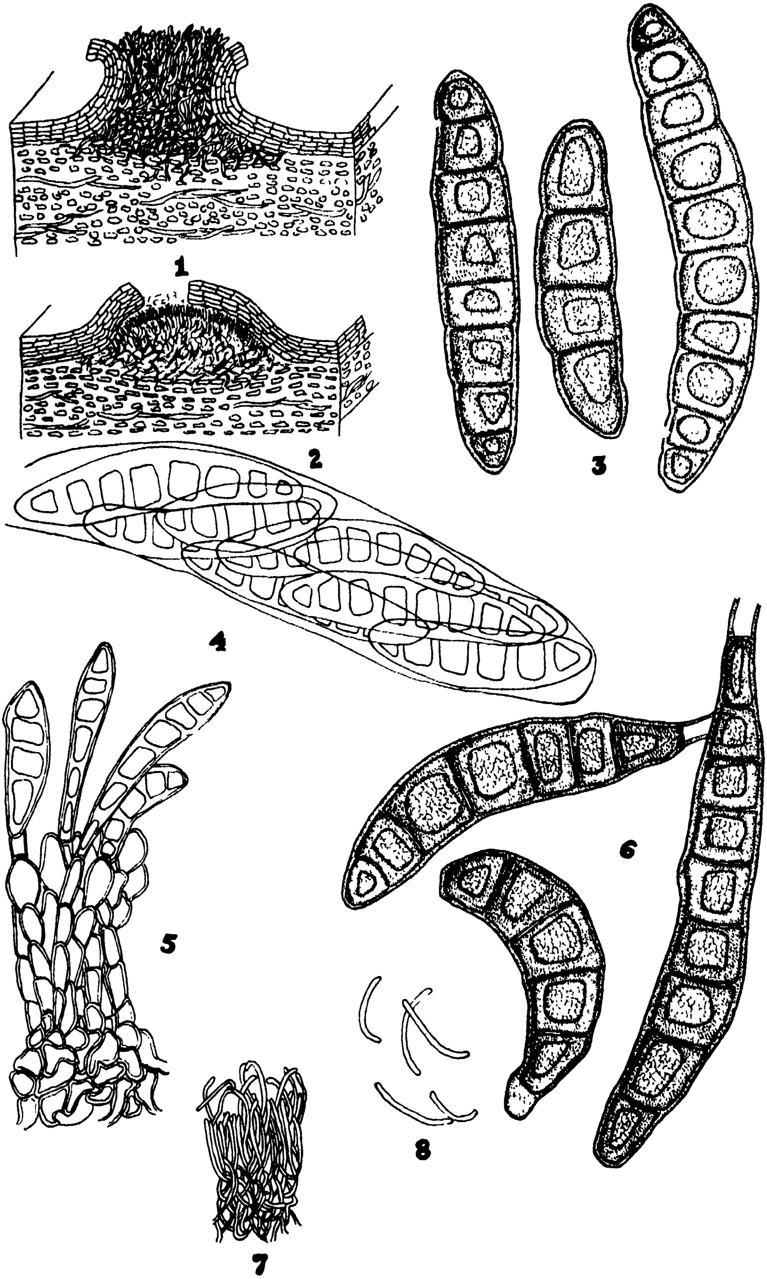
Fig. 8. Ascus with ascospores.



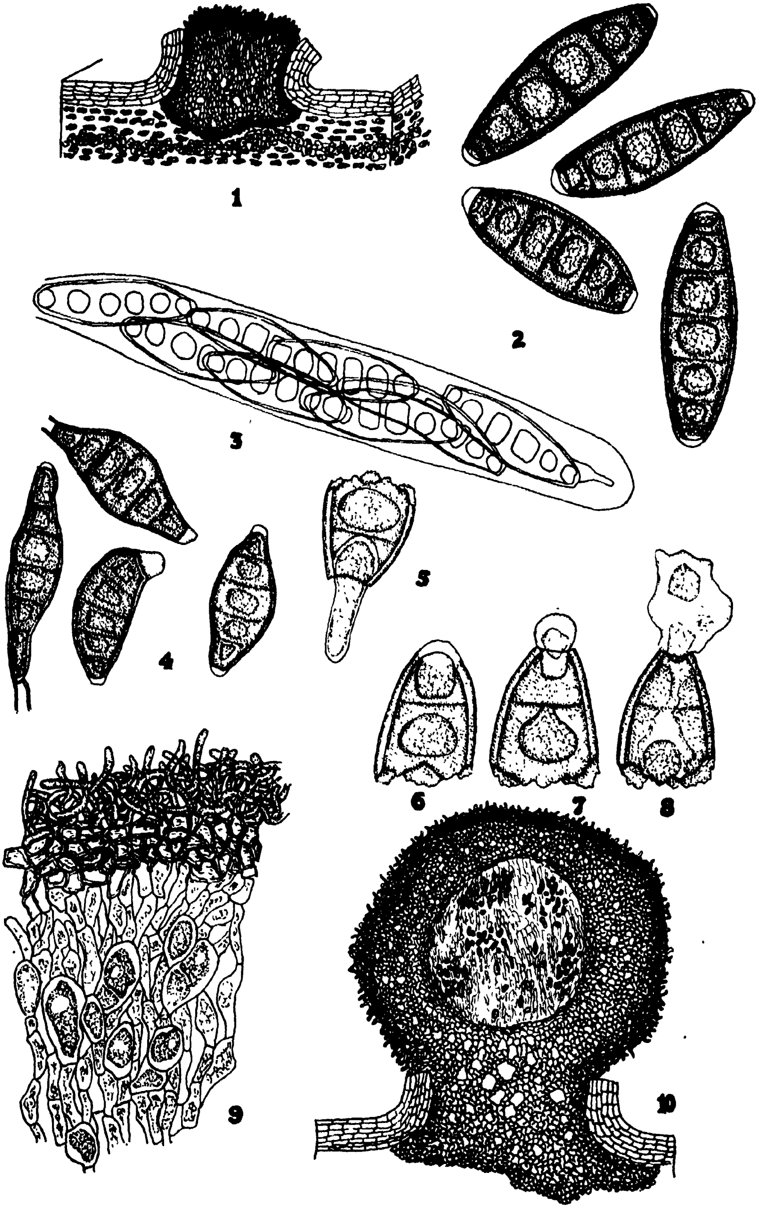
MELANCONIS AND PSEUDOVALSA



MELANCONIS STILBOSTOMA



PSEUDOVALSA LONGIPES



PSEUDOVALSA LANCIFORMIS

Fig. 9. Ascospores.

Fig. 10. Ascospores of *Melanconis spodiaea* Tul. from Rehm, Ascom. *1145.*

Fig. 11. Vertical section of perithecial stroma of *Pseudovalsa longipes* on *Quercus.*

PLATE 32

Pseudovalsa longipes (Tul.) Sacc.

Fig. 1. Vertical section of ectostroma bearing conidia of the *Coryneum* type, as formed on *Tilia* and *Quercus* in culture.

Fig. 2. Vertical section of ectostroma bearing conidia of the hyaline, curved or hamate type, as formed on *Tilia* and *Quercus* in culture.

Fig. 3. Ascospores.

Fig. 4. Ascus with ascospores.

Fig. 5. Portion of hymenial layer of ectostroma producing conidia of the *Coryneum* type.

Fig. 6. Conidia of the *Coryneum* type produced in culture.

Fig. 7. Portion of the hymenial layer of an ectostroma forming hyaline, filiform conidia.

Fig. 8. Hyaline, filiform, hamate conidia produced in culture.

PLATE 33

Pseudovalsa lanciformis (Fries) Ces. & De-Not.

Fig. 1. Vertical section of the *Coryneum* fruiting stage, as formed on *Betula* in culture.

Fig. 2. Ascospores.

Fig. 3. Ascus with ascospores.

Fig. 4. Conidia of the *Coryneum* stage produced in culture.

Fig. 5. Germinating ascospore, showing terminal protoplast growing out through the apical pore of the spore.

Fig. 6. End cells of ascospore, showing structure of the apical modified germ pore.

Fig. 7. Ascospore tip showing solution of apical germ pore, and emergence of terminal protoplast as a result of treatment with concentrated sulphuric acid.

Fig. 8. Ascospore tip, showing similar but more violent action resulting in ejection of several protoplasts and the gelatinous substance surrounding them in the spore.

Fig. 9. Portion of a vertical section of the pycnidial formations found in cultures on *Betula alba,* showing spore initials forming within the central hyaline tissue.

Fig. 10. Vertical section of such a mature pycnidial formation, showing conidia within an enclosed stromatic matrix.

OBSERVATIONS ON CALYPTOSPORA COLUMNARIS AND PERIDERMIUM ORNAMENTALE

JAMES ROBERT WEIR

(WITH PLATES 34 AND 35)

Hartig (6) was the first to demonstrate the life cycle of this rust in Europe. He used aecia on *Abies pectinata* and telia on *Vaccinium Vitis-Idaea* and obtained infections in both directions. Kuehn, Bubak and Winter fully verified the results of Hartig. In America the first successful cultures were made by Arthur (2) in 1909. He infected *Abies Fraseri* with telia on *Vaccinium pennsylvanicum* sent by Fraser from Nova Scotia. The aecial stage was collected by Fraser (3) in 1909 on *Abies balsamea*. This is the first American collection recorded from nature. In 1911 Fraser (4) reported successful inoculations on *Abies balsamea* with telial material from *Vaccinium pennsylvanicum*. Fraser (5) repeated this experiment in 1913, amply verifying the results of previous investigators.

The writer investigated this rust for several years, but not until 1918 were inoculation experiments successful. On Sept. 14, 1918, on the hills south of the Spokane River, opposite the town of Coeur d'Alene, Idaho, material with cylindrical aecia was collected on *Abies lasiocarpa* in considerable quantity. This material (No. *16210*) was taken across the river to the other side of the town about three miles away and in a pure stand of *Pinus contorta* in a moist ravine, the aeciospores were dusted over young shoots of an isolated clump of *Vaccinium membranaceum*. On Oct. 3, 1919, three shoots of the season were found characteristically deformed and swollen bearing the spongy telial layer (*16213*). When collected and placed in a damp chamber for a few days the teliospores were found in abundance within the epidermal cells. The rust on *Vaccinium* was not found anywhere in the neighborhood other than on the plant inoculated. The nearest firs were those from which the aeciospores were obtained.

The teliospores resulting from this inoculation were of the type described by Hartig, Arthur, Sydow, and others.

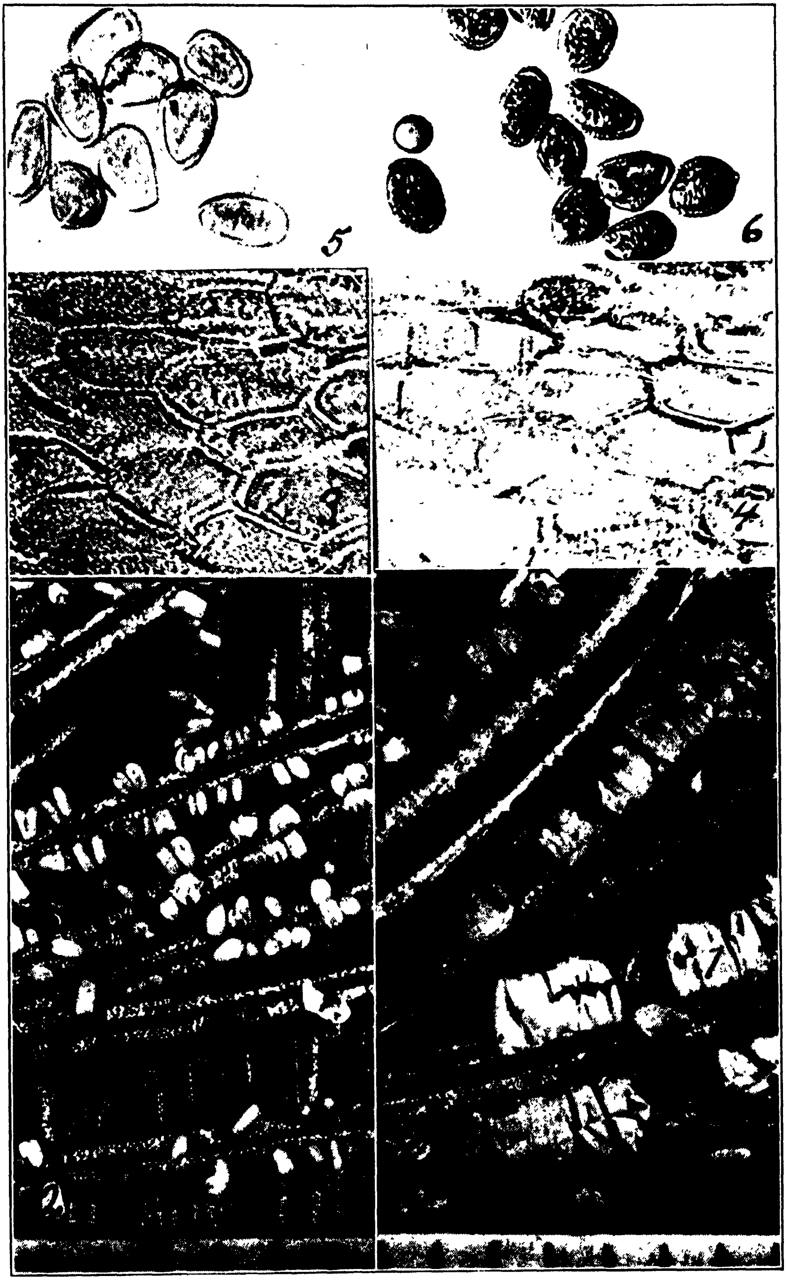
In September 1919 a successful inoculation experiment in the opposite direction was conducted by the writer at Coolin, Idaho. A small tree of *Abies lasiocarpa*, originally from Montana, and about one foot and a half high, was taken from the arboretum at Spokane, Washington, and transplanted alongside of a clump of *Vaccinium membranaceum* on which were several witches' brooms of *Calyptospora columnaris* (*16212*). One of the brooms with vigorous telial shoots of the season, and the crown of the young tree were tied together so that their branches intermingled. The plants were located in a deep ravine in a mixed stand of mature *Pinus monticola*, *Pseudotsuga taxifolia*, and some hard woods. There was very little sunlight at any season. The place was visited Aug. 13, 1920, and aecia with uniform cylindrical peridia were found sparingly on the leaves of the fir (No. *16211*). Since there was no chance for the fir to become infected previously, and its neighbors in the arboretum were free from the rust, it is safe to conclude that this experiment was successful. The microscopical characters of the aecia resulting from this experiment conformed to the established description for the species. Aecia were not found on any other tree in the vicinity.

According to Hartig (7) the sporidia may either directly reinfect *Vaccinium* or the leaves of *Abies*, in other words, to employ a term used by Frank, the rust is facultative heteroecious. This assertion is repeated in the Kew Bulletin (1907). Hartig gave no experimental evidence to support his statement other than the fact that the rust on *Vaccinium* occurred in districts from which the aecial host was absent. Direct telial infection of *Vaccinium* by means of sporidia has been attempted in four specific instances by the writer, but always with negative results. It has been possible, however, to infect young shoots of *Vaccinium membranaceum* with immature tissue taken from the upper extremities of telial infections on the same host. This was effected by inserting small pieces of this tissue into incisions in the terminal leaf axils before the teliospore layer is formed. Three such inoculations, well protected with cotton, were made in the open on May 13, 1919. On May 10, 1920, one of these inoculations had taken effect with the usual malformation of the young shoot of the host. This is comparable to the upward advance of the mycelium in young shoots from the previous year's infection.

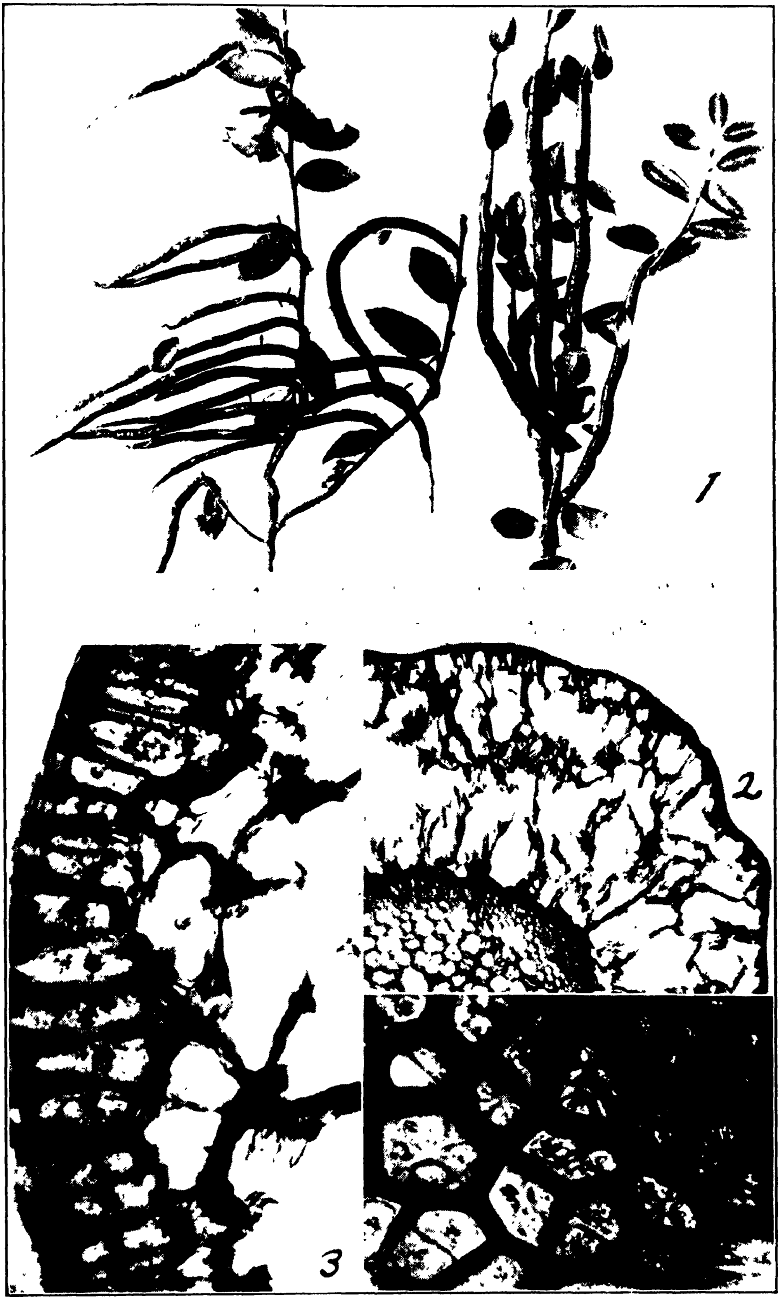
Arthur (1) refers to the pycnia of this rust as uncertain, and European authors have not reported this spore form. Pycnia, however, were found in a collection (*1227*) made by the writer at Columbia Falls, Montana, and reported in 1918 (8). The pycnia containing oval hyaline spores appear as brownish or black dots on either side of the midrib.

The most outstanding result from these experiments lies in the fact that the aecial form with small, narrow, uniform, cylindrical or columnar peridia (PL. 34, FIGS. 2, 3, 5) produced the typical telial stage on *Vaccinium* (PL. 35, FIGS. 1–3), and also appeared as a result of inoculation from telial material on this host. The aecia obtained by Fraser and Arthur were also of the small cylindrical type. This would imply that the telial material used would in all cases produce the same type of aecia and which is apparently different from the form on *Abies* which produces large cylindrical or flattened peridia described under the name *Peridermium ornamentale* Arth. and which is also associated with the rust on *Vaccinium*. The microscopical characters of the latter (PL. 34, FIGS. 1, 4, 6) are very similar to the aecial stage of *Calyptospora columnaris*, but the gross appearances of the two are very unlike. It is here proposed to reverse an earlier view on the identity of the aecial form on *Abies* with large cylindrical or flattened peridia and suggest the probability of their being another species of *Calyptospora* with telia on *Vaccinium*. This suggestion is based purely on field observations. All collections of the large aecial form so far made by the writer have been in close association with the typically appearing telial stage on *Vaccinium*. Wherever the large aecial form has been collected the form with small cylindrical peridia has been absent, with the reverse as true. Another view would be that the size of the aecia is influenced by the vigor of the host and that the two forms are identical.

Calyptospora columnaris is very destructive to various species



Peridermium ornamentale
Calyptospora columnaris



CALYPTOSPORA COLUMNARIS

of *Vaccinium* in the Western United States. Since the disease is of considerable importance on mountain cranberry (*Vaccinium Vitis-Idaea* and *V. corymbosum*) in the East, it is hoped that the problem of infection in regions far removed from aecial hosts and the identity of *Peridermium ornamentale* will be explained.

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ILLUSTRATIONS

Photographs by Dr. A. S. Rhoads and the writer unless otherwise indicated

EXPLANATION OF PLATES

PLATE 34

Fig. 1. *Peridermium ornamentale* on *Abies lasiocarpa*, Mt. Adams (Mt. Pado), Washington, Suksdorf, No. *588* (type).

Fig. 2. *Calyptospora columnaris* on *Abies lasiocarpa*, Fox Park, Wyoming.

Fig. 3. Peridial cells of *Calyptospora columnaris*. × 532.

Fig. 4. Peridial cells of type of *Peridermium ornamentale*. × 532.

Fig. 5. Aeciospores of *Calyptospora columnaris*. × 532.

Fig. 6. Aeciospores of type of *Peridermium ornamentale*. × 532.

PLATE 35

Fig. 1. Telial stage of *Calyptospora columnaris* on *Vaccinium ovatum*, Waldo, Oregon. Reduced.

Fig. 2. Cross section through the telial cushion showing nature of tissue and telial zone. × 35.

Fig. 3. Cross and longitudinal sections of teliospores. × 500. Photo. by F. L. Goll.

OCCURRENCE OF THE CURRANT CANE BLIGHT FUNGUS ON NUMEROUS HOSTS IN THE SOUTHERN STATES

NEIL E. STEVENS

(WITH 1 TEXT FIGURE)

Although the disease of cultivated currants (*Ribes* sp.), generally called cane blight, has been known for thirty-five years, and the causal organism was isolated and described in 1911, the occurrence of this fungus (*Botryosphaeria Ribis chromogena* G. & D.) on hosts other than currant was reported only two years ago.[1] Evidence is now in hand to show that *B. Ribis chromogena*, like the saprophytic and non-chromogenic *B. Ribis*,[2] occurs on numerous hosts far south of the limit of cultivation of the currant.

THE DISTRIBUTION OF CURRANT CANE BLIGHT

So far as is now known, currant cane blight is a serious disease only in the regions marked "C" on the accompanying map (FIGURE 1); that is, New Jersey and the Hudson Valley region of New York. Farther south very few currants are grown, though the occasional small patches found usually show the disease. Cane blight is also found to some extent in Massachusetts, Connecticut, northern New York and Ohio, though it has rarely been serious in these regions. Thus far the fungus has not been collected in Canada or Alaska even where currants are commonly grown.

THE ROT OF APPLES CAUSED BY THE CURRANT CANE BLIGHT FUNGUS

While studying certain fungi causing decay of apples, Fenner[3] proved that a rot indistinguishable from true black rot, due to

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[1] Stevens, N. E., & Jenkins, A. E., Occurrence of the Currant Cane Blight Fungus on Other Hosts. Jour. Agr. Res. 27: 837–844. 1924.

[2] Shear, C. L., Stevens, N. E., & Wilcox, M. S., *Botryosphaeria* and *Physalospora* in the Eastern United States. MYCOLOGIA 17: 98–107. 1925.

[3] Fenner, E. A., A Rot of Apples Caused by *Botryosphaeria Ribis*. Phytopathology 15: 230–234. 1925.

Physalospora malorum (Peck) Shear, was caused by *B. Ribis* and *B. Ribis chromogena.* The identity of this chromogen with the currant cane blight fungus was established not only by their agreement in morphological and cultural characters but by inoculation experiments. Healthy currant bushes were inoculated with cultures of the apple fungus, as well as cultures of the same fungus from rose (*Rosa setipoda*) and horsechestnut (*Aesculus Hippocastanum*) and typical cane blight produced. The currant cane blight fungus was found in decayed apples from the points indicated by "A" on the accompanying map (FIGURE 1), namely, Arlington Farm and Covesville, Virginia, and Fort Valley, Georgia.

THE CURRANT CANE BLIGHT FUNGUS IN THE SOUTHERN STATES AND CUBA

The discovery of the currant cane blight fungus on rose and horsechestnut, while establishing the fact that the fungus could grow on hosts other than *Ribes* sp., did not extend its known range. Even its occurrence on apples at Fort Valley, Georgia, might have been due to the fungus being brought in on apple or peach stock. Subsequent study has proved, however, that the fungus is well established on numerous native hosts in Georgia and Florida.

During a collecting trip in the winter and spring of 1924 the writer found *B. Ribis chromogena* on *Cassia* sp., *Hicoria Pecan* and *Gossypium hirsutum* in Georgia, and on *Amygdalus Persica*, *Baccharis* sp., *Berberis* sp., *Laguncularia racemosa*, *Liquidambar Styraciflua*, *Liriodendron Tulipifera*, *Magnolia* sp., *Poinciana pulcherrima*, *Quercus* spp. (two specimens), *Ricinus communis*, *Salix* spp. (four specimens), *Sambucus* sp., and several unidentified hosts in Florida. Recently the same fungus was found by G. M. Darrow on cultivated raspberries in Florida. The localities in which these collections were made are approximately indicated on the accompanying map by dots. Reference to the map shows that the fungus was found in various parts of Florida and was collected several times in the extreme southern end of the peninsula. It is then not surprising that it was also found during a brief collecting trip in Cuba in January, 1925, on cut branches of *Acalypha marginata* growing on the estate of F. S. Earle at Herradura.

In most cases the fungus was found on cut branches of the hosts named but the material from cotton came from an old root and that from pecan was found on a tree which had been killed by lightning.

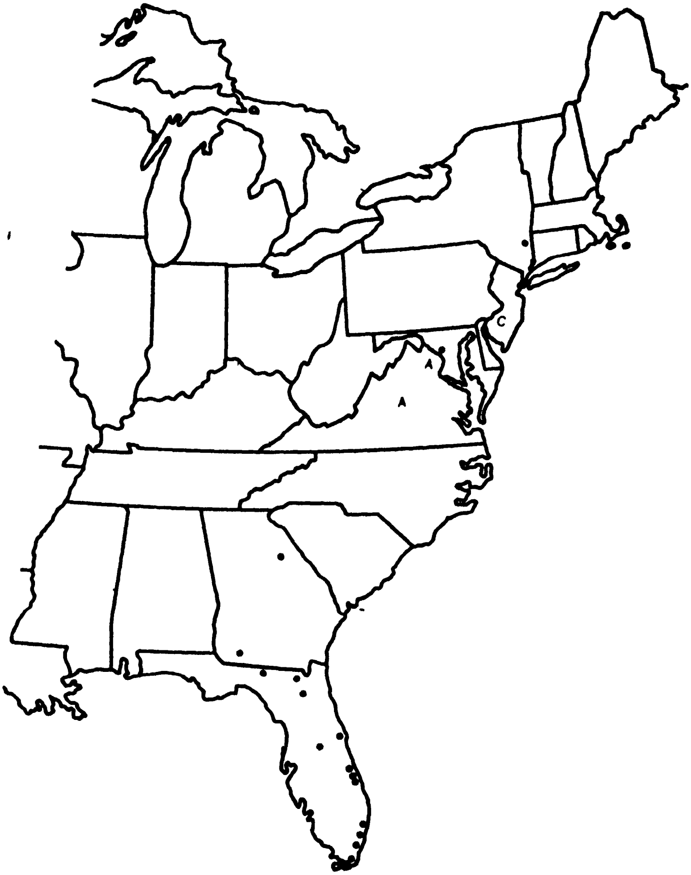

FIG. 1.—Outline map of the eastern portion of the United States showing localities in which currant cane blight fungus has been collected. "A" indicates places where it has been found causing decay of apples. "C" indicates localities in which currant cane blight is severe. Dots indicate collections on other hosts.

As has been pointed out several times it is as yet impossible to distinguish *B. Ribis* (which is saprophytic on currants) from the parasitic *B. Ribis chromogena* by morphological characters. Consequently, single ascospore cultures were made from all specimens on which good ascospores were found. Those listed in the foregoing paragraph as the currant cane blight fungus are those which not only agreed with *B. Ribis* in ascospore measurements and in the size of the pycnospores produced in pure culture from single ascospores but also when grown on corn meal paste showed the pink color characteristic of the parasite.

It was impractical and seemed unnecessary to make inoculations on currant with each of the twenty-nine different numbers which were secured in pure culture. Inoculations on healthy currants were, however, made with the material from Cuba, as well as with one culture from Georgia and one from Florida. In each case the typical cane blight was produced. It is thus apparent that the currant cane blight fungus actually occurs on native hosts in the southeastern United States and in Cuba.

GENERAL CONSIDERATIONS

From the facts now available it is evident that in *Botryosphaeria Ribis chromogena* we are dealing with a fungus whose range only partly overlaps that of the host on which it has been longest known and on which it is most destructive. Cane blight is so severe toward the southern limits of cultivation of the currant that it has never yet been successfully controlled in large plantations. A little farther north the disease is apparently severe in certain seasons and much less destructive in others. Then comes a region where the fungus is usually present on dead currant canes but has never been known to cause serious damage. While in northern New England, Canada, and Alaska, even in those regions where the currant is commonly grown, neither the cane blight fungus nor the saprophytic *Botryosphaeria Ribis* has yet been found on any host.

South of the area of cultivation of the currant, on the other hand, even in tropical and sub-tropical regions more than a thousand miles from the region where the currant is grown commercially, the currant fungus is apparently fairly common on a variety of hosts. These facts suggest that the fungus was originally confined to native hosts of southern range and that the introduced species of currant proved susceptible to its attacks when grown within the region of its natural range. This suggestion seems to be supported by the fact that the fungus has not been found on the currant in Europe.

SUMMARY

The currant cane blight fungus, *Botryosphaeria Ribis chromogena*, has been found on numerous hosts, many of them native species, in Georgia and Florida; and once in Cuba.

The range of the fungus thus extends much farther south than that of the currant. On the other hand, the fungus has not yet been found on any host in the northern portions of the region in which currants are commonly grown.

BUREAU OF PLANT INDUSTRY,
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NOTES AND BRIEF ARTICLES

Professor F. L. Stevens sailed early in June for a three months stay in Europe in the interests of mycology.

Professor C. R. Orton has been granted an extension of leave of absence from Pennsylvania State College, in order to continue his work at Boyce Thompson Institute in research on seed-borne diseases for the Bayer Company, Inc.

Dr. G. H. Godfrey of the Boyce Thompson Institute has resigned his position from the Bayer Company to take a position as pathologist with the Association of Hawaiian Pineapple Canners with headquarters at Honolulu. His entire time will be devoted to research on the pineapple diseases.

Under the title "ADNA," Sammlung *A*us *D*er *Na*tur, Band 4/5 Pilze, Professor Dr. Spilger has recently issued a convenient little handbook of some of the higher fungi including Boletaceae, Polyporaceae, and Hydnaceae. This handbook is of pocket size and consists of 96 pages of text together with 32 beautifully colored plates, each plate illustrating on the average about six species. The text is in German. The book would be exceedingly useful as a field guide. A similar handbook on American species with English descriptions would be still more useful for the American student.

Dr. L. C. Coleman, formerly Mycologist to the Government of Mysore, India, and for the past thirteen years Director of Agriculture in that State, has returned to Canada on leave on account of ill-health. He has been spending the past seven months working in the Department of Botany of the University of Toronto investigating particularly spore-structure in the Polyporaceae.

Dr. L. O. Overholts, of the Pennsylvania State College, accompanied by Mrs. Overholts, and Dr. and Mrs. J. B. Hill spent the early part of the summer in an expedition by auto to the Black Hills, the Yellowstone, and the Colorado Rockies. This is the fourth collecting trip Dr. Overholts has made to the Rockies. They left State College, Pennsylvania, July 1, and returned in time for the Ithaca meeting in August. They made extensive collections of the flowering plants and fungi, and gave some attention to the algae growing in the hot springs of the Yellowstone.

Dr. Howard J. Banker recently returned from a stay of several weeks in Florida where he had been recuperating from a spell of severe illness. Dr. Banker brought with him a number of interesting fungi, among these an unusually large specimen of *Scleroderma Geaster*, a species which was collected commonly by us in Bermuda during the past winter. The fungus occurs submerged in the sand appearing above the surface only after it has ruptured and disseminated its spores. The Florida specimen turned over to the New York Botanical Garden by Dr. Banker was much larger than those collected in Bermuda. Other interesting collection were obtained. F. J. SEAVER.

Word has been received of the death, on July 1, 1926, of Dr. Carlos Spegazzini. After having studied under Beccari and Saccardo in Italy, Dr. Spegazzini turned his attention to the virgin field of the South American flora and in 1880 he published his first contribution to the flora of Argentina in which 140 fungi are listed, most of them new to the Republic. For more than forty-five years he devoted his time to the study of the flora of South America, publishing about 150 papers, not only on fungi but on flowering plants as well. With the death of Dr. Spegazzini mycology loses one of its great leaders and Argentina a true benefactor. RAFAEL A. TORO.

The many friends of the well known mycologist, Curtis G. Lloyd, of Cincinnati, Ohio, will be pleased to know that the University of Cincinnati at the June Commencement Exercises conferred upon Mr. Lloyd the honorary degree of Doctor of Science in recognition of his contributions in the field of mycology. Mr. Lloyd was presented for the degree by Dr. Benedict of the Botany Department of the University.

It is with extreme regret that we learn that Dr. Lloyd has recently been afflicted with failing eyesight to such a degree that it has been necessary for him to abandon his work with fungi at least for the present. H. M. FITZPATRICK.

"CITRUS DISEASES AND THEIR CONTROL"

We have recently received for notice in MYCOLOGIA, under the above title, a book of 582 pages (with many illustrations including a number of colored plates) by Howard S. Fawcett, Professor of Plant Pathology, Graduate School of Tropical Agriculture and Citrus Experiment Station, University of California, and formerly Plant Pathologist, Florida Agricultural Experiment Station. The book also contains sections on Oriental Citrus Diseases by H. Atherton Lee, Plant Pathologist, Experiment Station, Hawaiian Sugar Planters Association and formerly Plant Pathologist, Philippine Bureau of Science.

The introductory chapter is devoted to the history of *Citrus* disease investigation and a discussion of the species of the genus *Citrus*, consideration being given to the structure and physiology of the plants of the genus. In the second chapter, the types of citrous diseases are fully discussed. The term disease is here used in a broad sense to include those caused by animal organisms as well as those due to plant parasites. Physiological diseases are also considered.

After looking over this voluminous work we wonder that anyone would be brave enough to undertake the cultivation of any fruit which is subject to such great variety of maladies. However, as the author has suggested, comparatively few of these diseases are present in any one place and many of them are of minor importance so that after all the cultivation of citrous plants is probably no more hazardous than any other horticultural venture.

The book represents the results of long years of investigation and study and is doubtless a very complete compilation of the diseases of these plants and the most up-to-date methods of controlling them. F. J. SEAVER.

A NEW SMUT

During the summer of 1925, the writer had the pleasure of directing a class of graduate students in biological research at the Alpine Summer School of Brigham Young University. This summer school is located at Aspen Grove, in the heart of the Wasatch Mountains. Among the many interesting specimens brought in by the enthusiastic and energetic members of the class, there is one—a smut—of more than usual interest. I can find no similar smut recorded in literature, and I here propose it as a new species. I take pleasure in naming it in honor of Mr. Seville Flowers, one of the most indefatigable collectors of the class. The following description has been checked by Mr. George Zundel, to whom thanks are due.

Urocystis Flowersii Garrett, sp. nov. Sori amphigenous in the leaves, broadly elliptical and occasionally confluent; lead-colored, becoming dark brown, 2–5 × .5–1 mm. Spore-balls irregularly oblong to quadrangular, dark brown, very variable in size, 20–42 × 25–75 μ, mostly averaging about 33 × 42 μ. Sterile cells subglobose to elliptical, 5–8 × 13–16 μ, pale yellowish-brown, completely enveloping the spores. Spores 5–7 or occasionally 8 or more, in the ball; 8 × 8 μ.

On *Zygadenus elegans* Pursh. Collected by Seville Flowers, Glacier Cirque, Mt. Timpanogos, above Aspen Grove, Wasatch Mts., Utah Co., Utah, August 8, 1925. Altitude about 11,500 ft.

A. O. GARRETT

GAUMANN'S VERGLEICHENDE MORPHOLOGIE DER PILZE [1]

Over forty years have passed since the classic work of DeBary on this subject appeared and thirty-four years since von Tavel's work on the same subject was published. In the meantime many additions have been made to our knowledge of the fungi. The numerous important papers which have appeared are scattered through the scientific literature of the world and written in many languages. To summarize and coördinate this great mass of material is a difficult matter. This task has now been undertaken by Doctor Gäumann and accomplished in a very commendable manner.

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[1] Gäumann, E., Vergleichende Morphologie der Pilze, 8°, 626 pp., 398 text figs. Gustav Fischer, Jena. Price, bound, 30 marks, unbound, 28 marks.

The term fungi as defined by the author is restricted to chlorophyll-free Thallophytes, excluding the bacteria and Myxomycetes. The lichens, however, are recognized as fungi. The work is divided into two parts. The first part is devoted to general morphology and covers 14 pages. The second part is devoted to the morphology of the different groups. Much attention is naturally given to recent developments in the cytology of the fungi. Arrangement of the groups and the general treatment of the subject is based upon the so-called sexual nuclear phenomena and organs. The author recognizes, however, that our knowledge of this subject is very incomplete and that there is great diversity and difficulty in coördinating the available data. The results of the many recent efforts of mycological investigators to discover and describe the nuclear fusions and reduction divisions in many scattered cases have led some to believe that this line of investigation will provide the best means of determining the derivation and relationships of the various groups.

In the course of the long and diverse evolution of the fungi from their algal ancestors many changes in the form and function of the original reproductive organs have naturally taken place, making it extremely difficult to coördinate the more or less vestigial organs and diverse nuclear phenomena. Much more information and in general of a more dependable character must be obtained before any safe general conclusions can be reached.

The general presentation of the subject given by the author indicates the present state of our knowledge and shows where thorough studies of the nuclear phenomena in reproduction are most needed, and should stimulate more work in this direction.

Attempts to coördinate and evaluate our present knowledge of the life history of the pleomorphic species are also very unsatisfactory and indicate how urgent is the need for more and better work in this direction. Any one seeking a field for biological investigation can scarcely find one in which the possibilities of making important additions to our knowledge are greater than in the morphology and cytology of fungi.

The literature discussed and cited includes the most important papers which have appeared and of course also some of little value. This is inevitable as it is difficult without knowing each author and his training and methods of work to tell whether his statements and conclusions are dependable or not.

The illustrations are numerous and well chosen, and the character of the typographic work is in keeping with the previous good record of the publishers. The work is almost indispensable to every teacher of mycology and advanced student of the fungi.
C. L. SHEAR.

A MYCOLOGICAL OMELET

In volume 9 of the American Midland Naturalist (date not given on the reprint) there appeared an article of 265 (interleaved) pages entitled "The Native Flora of the Vicinity of Cold Spring Harbor, L. I., N. Y.," by N. M. Grier. Most of the article is devoted to listing the plants of that locality, from bacteria to flowering plants, inclusive. Mention is made of the article here to illustrate the gross blunders that may easily be made when an outsider gets into a taxonomic field in which his horizon is evidently limited by the small number of species that a college graduate in botany might be expected to know. Without further discussion I cite the following examples from the group of the fungi as listed in this paper.

Page 74. Misspellings readily recognizable in the Ascomycetes are: *Ascophonus* [*Ascophanus*], *Asperpillus* [*Aspergillus*], *Ustilina* [*Ustulina*], and *Sphaerotheca Castagni* [*Castagnei*].

Page 80. Basidiomycetes. In the first family (Agaricaceae) two species and one variety of *Boletinus*, properly referred to the Polyporaceae or the Boletaceae, are listed. Also one finds *Agaricus diminutivus*, and *Psalliota campestris*, both referable either to *Agaricus* or to *Psalliota*, but cogeneric.

Page 82. *Leptoglossum*, an Ascomycete, is listed in the Agaricaceae.

Page 84. *Calocera cornea* and *Dacryomyces chrysocomus* are listed as the two members of the Auriculariaceae, both belonging to the Dacryomycetaceae. *Calastoma cinnabarium* is obviously misspelled [*cinnabarinum*].

Page 86. *Lachnocladium Michenecri* [*Micheneri*] is a slander on Michener. *Stereum versicolor* is not present on Long Island, being a tropical or subtropical species. *Sterigmatocystis* sp. is listed under the Corticiaceae, when it should be referred to the Ascomycetes. There are no species of *Corticium* listed under the Corticiaceae, but *Corticium comedans* is listed under the next family Exobasidiaceae, as is also *Hirneola Auricula-Judae* which should have come under the Auriculariaceae (see p. 84).

Page 90. *Rhytisma acerinum* and *R. Solidaginis* (the latter doubtfully autonomous at best) are listed under the Phallaceae, that includes the "stink horns." We have never noticed an odor to these ascomycetous species that would suggest such a relationship. On the same page the specific part of *Boletus Frostii* is capitalized but *B. Russelli* and *Cyclomyces Greenei* are not.

Page 92. Both *Polyporus cinnabarinus* and *Polystictus cinnabarinus* are listed, while on the next page the same plant (presumably) is referred to as *Trametes cinnabaria* (misspelling for *cinnabarina*).

Page 94. *Simblum rubescens* and *S. sphaerocephalum*, both good Gasteromycetes, are listed among the Polyporaceae. Two (at least) misspellings occur on this page.

Page 96. *Sphaerobolus carpobolus* is written *S. carpololus* and an "i" is omitted from the specific part of *Craterellus cornucopioides*. The family Thelephoraceae contains the genera *Craterellus*, *Hymenochaete*, *Michenera* (misspelled) and *Solenia* (the latter belonging to the Polyporaceae), while *Stereum* is included in the family Corticiaceae on a preceding page. One wonders in what way the family limits have been shifted to permit this.

I have not examined the other plant groups in the list for mistakes. The preceding examples are sufficient warning about straying into unknown pastures. Presumably those lists may be expected to be more correct, especially through Pteridophytes and Spermatophytes, where undoubtedly the author of the paper is much more at home, and to which he should have confined his interests. In this connection, however, the reader is referred to Taylor's critical comment in the December (1925) number of Rhodora, pages 213–215.

An unfortunate thing in connection with the paper is that various botanists of repute are cited as partially responsible for the lists, some in one way and some in another. One can well imagine their chagrin in perusing a list containing such absurdities as given above. The reviewer has always been a stickler for giving credit to whom credit is due in scientific writings, but the foregoing casts doubt on the advisability of this unless opportunity is given to see the manuscript in proof. He is at least well content not to have contributed anything to this list.

Lists, properly made up, are no doubt of very great importance in the taxonomic literature, and their publication should be encouraged. But let us hope that there will be no more of the particular type here discussed. Fortunate it is that the article appeared in a magazine of limited circulation among scientists, so that probably few people will have occasion to read the list critically. The interpagination is doubly fortunate, serving for corrections as well as additions.

L. O. OVERHOLTS.

THE INTERNATIONAL CONGRESS

The International Congress of Plant Sciences held in Ithaca, August 16–23, 1926, was an event of no mean importance in the history of American botany. While mycology was only one of the thirteen sections into which the congress was divided it was in itself an important meeting. The section was presided over by E. J. Butler of the Imperial Bureau of Mycology of Kew, England, with H. M. Fitzpatrick of Cornell University as permanent secretary, assisted by J. H. Miller of the University of Georgia.

Many interesting papers were presented. Classification and the delimitation of species were subjects which provoked a lively discussion and occupied a great deal of the time allowed for debate. The principal conflict seemed to be between the morphological mycologists on the one hand, or those who would classify fungi on morphological characters only, and physiological mycologists on the other, or those who would classify fungi on their behavior or reaction to substratum without regard to morphological characters.

Questions of nomenclature also received considerable attention both in the section of Mycology and also in the section of Taxonomy which the taxonomic mycologists were especially invited to attend on Thursday afternoon. Committees were appointed to submit propositions for consideration at the next congress to be held in London in 1930. FRED J. SEAVER.

IN MEMORY OF GEORGE F. ATKINSON

On August 20, in connection with the meeting of the International Congress of Plant Sciences, at Ithaca, the memory of the late George F. Atkinson was honored by his students and friends at an informal luncheon held in Willard Straight Hall. This was the first time that the students of Atkinson had ever officially gathered together and for some it was the first time that they had ever returned to Ithaca to find him gone. The arrangements were in charge of Dr. J. M. Reade, head of the Department of Botany, University of Georgia. The speakers were Dr. B. M. Duggar, Dr. K. M. Wiegand, Dr. H. S. Jackson, and Dr. H. P. Brown. The following were present: J. C. Arthur, M. F. Barrus, H. P. Brown, W. H. Burkholder, Bradley Moore Davis, W. H. Davis, Gertrude C. Douglas, B. M. Duggar, Caroline Allen Dunham, Arthur J. Eames, C. W. Edgerton, J. H. Faull, Margaret C. Ferguson, H. M. Fitzpatrick, C. Stuart Gager, Margaret A. Graham, Henry Hicks, B. B. Higgins, David F. Hoy, Mitsuharu Ishakawa, H. S. Jackson, Anna E. Jenkins, W. L. Jepson, Robert Matheson, J. C. Needham, Susan P. Nichols, Abigail O'Brien, Alice M. Ottley, H. G. Perry, J. Ramsbottom, J. M. Reade, Donald Reddick, Silence Rowlee, Huron H. Smith, R. E. Stone, J. M. Van Hook, Leva B. Walker, H. H. Whetzel, Maude Cipperly Wiegand, K. M. Wiegand, Anna Allen Wright, A. H. Wright.—H. M. FITZPATRICK.

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